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MCDONNELL DOUGLAS

### PERFORMANCE ANALYSIS AND DESIGN SYNTHESIS (PADS) COMPUTER PROGRAM VOLUME II

VOLUME II
Program Description

Part 1 Final Report

**NOVEMBER 1972** 

MDC G4287

PREPARED UNDER CONTRACT NO. NAS9-12059
BY GUIDANCE AND FLIGHT MECHANICS DEPARTMENT,
RESEARCH AND DEVELOPMENT
MCDONNELL DOUGLAS ASTRONAUTICS COMPANY—WEST
HUNTINGTON BEACH, CALIFORNIA
FOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

#### MCDONNELL DOUGLAS ASTRONAUTICS COMPANY-WEST

5301 Bolsa Avenue, Huntington Beach, CA 92647

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(NASA-CR-128678) PERFORMANCE ANALYSIS AND
DESIGN SYNTHESIS (PADS) COMPUTER PROGRAM.
VOLUME 2: PROGRAM DESCRIPTION, PART 1
Final (McDonnell-Douglas Astronautics Co.)
760 D HC
CSCI 22A G3/30 50668

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#### FOREWORD

This is the second of three volumes describing the Performance Analyses and Design Synthesis (PADS) computer program. This volume is devoted to programming and numerical techniques. Volume I contains a complete program formulation and Volume III is a users manual.

The development of PADS was conducted by McDonnell Douglas Astronautics Company at Huntington Beach, California, under NASA contract NAS 9-12059, under the cognizance of Mr. Robert Abel, NASA, MSC, Houston, Texas. The key MDAC personnel who formulated and programmed PADS are Messrs. Murray H. Rosenberg, John W. Hensley, and Michael Beach. Valuable programming assistance was given by Larry Ong, Fred Gangloff, and Sheldon Herman.

#### ABSTRACT

The Performance Analysis and Design Synthesis (PADS) computer program has a two-fold purpose. It can size launch vehicles in conjunction with calculus-of-variations optimal trajectories and can also be used as a general-purpose branched trajectory optimization program. In the former use, it has the Space Shuttle Synthesis Program as well as a simplified stage weight module for optimally sizing manned recoverable launch vehicles. For trajectory optimization alone or with sizing, PADS has two trajectory modules. The first trajectory module uses the method of steepest descent; the second employs the method of quasilinearization, which requires a starting solution from the first trajectory module.

# Section 1 INTRODUCTION

The PADS computer program is actually a merger of four separate programs. Each of the separate programs, hereafter called modules, has its own function to perform. Above all of these modules is a main program which calls the appropriate modules into action whenever the problem at hand requires. This main program also controls auxiliary activities concerned mainly with reading in data and communicating data from one module to another. The main modules and auxiliary functions fit naturally into an overlay structure which permits loading this very large program into a moderate core size on either the CDC 6000 or UNIVAC 1108 computer. This overlay structure is illustrated in Section 2 of this volume. The basic modules and auxiliary functions of PADS are listed and defined below.

#### Basic Modules

Overlay	Name	Abbreviation	Purpose
(3, 0)	Steepest Descent	SD or TOPM	Optimize trajectory and staging approximately and provide starting solution for the quasi-linearization module
(4, 0)	Quasi-Linearization	QL or GROPE	Solve Euler-Lagrange boundary value problem (calculus of variations)
(6, 0)	Phase I Sizing	SIZE	Synthesize generalized two- stage launch vehicle (simple sizing)

Overlay	Name	Abbreviation	Purpose
(7, 0)	Space Shuttle Synthesis Program	SSSP	Synthesize two-stage manned recoverable launch vehicle
	Aux	iliary Functions	
(1,0)	INPUT Editor	INEDIT	Read NAMELIST type input and store input data on file for access by various modules
(2,0)	First Input Scan	GEINP	Scan and prepare basic input data for SD and/or QL module execution
(3, 1) -	Second Input Scan	SDINP	Scan boundary conditions and set up steepest descent module data
(5,0) .	Sizing Trajectory	SIZIN	Alter weights and other physical data according to sizing computation in SSSP or SIZE module in prepar- ation for trajectory computation

This volume is organized according to the structure of the program. The next section describes how the main program and auxiliary functions interact with and permit communication between modules. Descriptions of the coding in each module are given in later sections.

The coding documentation includes subroutine glossaries, listings, flow charts, and descriptions of purpose and logic flow. Where possible, subroutine descriptions are tied back to the formulation document.

The documentation of each module consists of the description of the executive program, followed by a set of common glossaries pertinent only to that module. This is followed, in turn, by alphabetically ordered subroutine descriptions.

The final section of this volume contains a discussion of ground rules for modifying the computer program.

PADS Main Program

### CONTENTS

### Overall PADS Program Organization

### UNIVAC Logic Unit Description

Program	PADS
Subroutine	PADS1
PA DS	Overlay Structure
Block	/ARCDAT/
Block	/BICUBE/
Block	/GLØBAL/
Block	/LASTAB/
Block	/ØRBIT/
Block	/SIZING/
Block .	/TABLE/
Subroutine	CØØRDS
Subroutine	CRASH
Subroutine	DCTØE
Subroutine	INBVAD
Subroutine	ISPRAT
Subroutine	MATADD
Subroutine	MTMLT
Subroutine	PAGES
Subroutine	PAYLØD
Subroutine	PRINT
Subroutine	SPLIZ
Subroutine	TABIN
Subroutine	WTDRP

# Section 2 OVERALL PADS PROGRAM ORGANIZATION

The main program of PADS is called PADS1. Its flow chart is presented in a figure, with listing and glossary of terms placed directly after. The listings given in this section are flow-listed to indicate transfers within each routine. The listings have been made for the CDC 6500 version of PADS, with some notes where appropriate to indicate differences in the UNIVAC version. A key difference between CDC and UNIVAC listings is that the CDC listing contains a complete picture of all common blocks, whereas the UNIVAC listing only has INCLUDE statements for the common blocks.

Following the PADSI description is a diagram of the PADS overlay structure, and COMMON block glossaries and subroutine descriptions that are shared by different modules.

### Program PADS

### Purpose

Program PADS is a dummy main program used to call the main executive routine, PADS1.

### · Description

The CDC version of PADS defines the required logical units in its argument list. The UNIVAC version has no such requirement.

PADS

PROGRAM PADS(INPUT=1002, OUTPUT=1002, TAPE6=GUTPUT, TAPE5=INPUT, #TAPE1=1002, TAPE12=1002, TAPE4=1002, TAPE10=TAPE12)
CALL PADS1
END PADS AAA PADS PADS

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N

# SUBRØUTINE PADS 1

# SUBRØUT INE PADS 1

# SUBRØUT INE PADS 1

#### Subroutine PADS1

### Entry Points SIZERR, SDERR, QLERR

### Purpose

PADSI is the main executive routine for the PADS program.

### Description

As the main executive routine, PADS1 calls in the various modules of the program. These modules, shown in the PADS OVERLAY STRUCTURE, are actually a block of coding headed by an executive routine. The way that PADS1 calls in a module is different in the UNIVAC system than with the CDC software. The CDC software requires calls to the OVERLAY routine to bring in the program module, whereas in the UNIVAC version, simple calls to the appropriate executive routine are used. (See program flow list.) Additional differences in the UNIVAC version of PADS1 exclude the use of blocked binary files\* and the sharing of file buffers. \*\* These aspects are not available or necessary on the UNIVAC machine. In the CDC version the routines OPENMS, READMS, and WRITMS are FORTRAN library routines \*\*\* that set up, read, and write on random access storage. The UNIVAC version of PADS has special versions of these routines that in turn call-UNIVAC-MSC peculiar routines RINIT, RREAD, and RWRITE (random access drum storage and retrieval routines).

The CDC 6000 system of disc storage is entirely logical unit number-oriented whereas random storage on the UNIVAC-MSC system is not. Following is a chart showing how non-core storage is set up on the UNIVAC system.

#### Entry Points

The entry points SIZERR, SDERR, and QLERR are control error returns that are called from various points in the different modules to return control to the proper place in the executive routine (PADS1). Depending on flag setting, corrective action is taken or the next case of input data is requested.

<sup>\*</sup>CDC listing: CALL FTNBIN (1, 3, IBLKN). See CDC Scope 3, 0 manual.

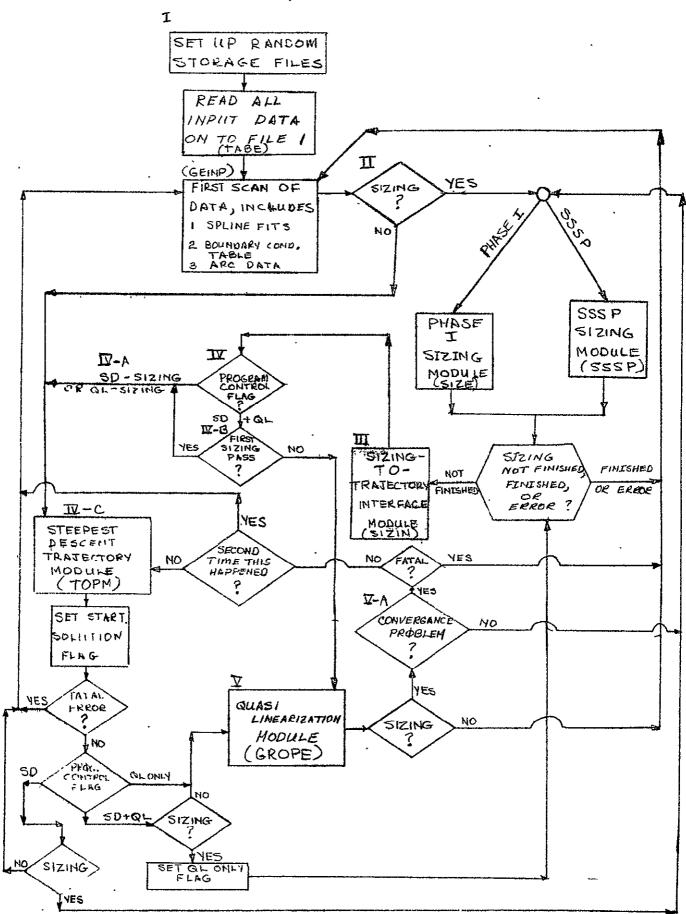
<sup>\*\*</sup>CDC listing: CALL EQUBUFF (5LINPUT, 10, IIN, IFET, IEF)

<sup>\*\*\*\*</sup>CDC FORTRAN Manual

### UNIVAC Logical Unit Descriptions

Internal Logical Unit Number	Purpose	Type	Description
1	Input data file created by INEDIT	FASTRAND	Control card assigned as FASTRAND file 'A'
3	Scratch random file used by INEDIT	H.S. Drum Random	Automatically assigned to second half of drum to overflow on to FASTRAND
14	INEDIT scratch and Q-L Scratch	H.S. Drum Sequential	• •
5	INPUT	Card Reader	
6	OUTPUT	Printer	
9	Arc data and boundary conditions	H.S. Drum Random	Automatically assigned to second half of drum to overflow on to FASTRAND
10 .	Scratch file used in TRAN3	FASTRAND	Assigned as FASTRAND file 'H'
11	Starting solution file	FASTRAND or Tape	Assigned as File I either tape (to save) or FASTRAND
12	Used in Q-L solution	H.S. Drum sequen- tial	Automatically assigned to first half of drum
33 .	Bivariant aero coefficients set number 6	H.S. Drum Random	Automatically assigned to second half of drum to overflow on to FASTRAND
34	Bivariant aero, coefficients set number 7	H.S. Drum Random	Automatically assigned to second half of drum to overflow on to FASTRAND
35	Bivariant aero coefficients set number 8	H.S. Drum Random	Automatically assigned to second half of drum to overflow on to FASTRAND
<u> 3</u> 6	Bivariant air breather engine data set number 9	H.S. Drum Random	Automatically assigned to second half of drum to overflow on to FASTRAND
39	Steepest descent trajectory storage	H.S. Drum Random	Automatically assigned to second half of drum to overflow on to FASTRAND
40	Steepest descent trajectory storage	H.S. Drum Random	Automatically assigned to second half of drum to overflow on to FASTRAND
41	Steepest descent adjoint storage	H.S. Drum Random	Automatically assigned to second half of drum to overflow on to FASTRAND

## PADS1



FORTRAN	HTAM	CODE	DESCRIPTION	STORAGE			NE USAGE
SYMBOL	SYMBQL	CODE	DESCRIPTION .	BLOCK	LOC	SUBR CO	DE VAR
1 1		,					
CAR		0	Constant, 1715.4827	/DATA /(	8")	PADS1 T	CAR
ER -	•E <sub>R</sub>	ī	Earth radius. (FT)	/GLOBAL/(	2)	COORDS I CRASH I EQUAS : I GEINP I PADS1 I PDBC I SOMG I TRTOSZ I	REM ER ER ER ER ER
FTNM		9	Feet to naut. mi. conversion, 1.645791629x10 <sup>-4</sup>	/DATA /(	7)	OUT 1 PADS1 ( TRTOSZ 1	FTNM
GM	GM	0	Product of Newton's universal gravitational constant and the mass of the earth. (FT <sup>3</sup> /SEC <sup>2</sup> )	/GLOBAL/(	67)	CRASH 1 OUT 1 PADS1 C PDBC 1	GM GM
<b>GR</b>	g <sub>r</sub>	Ī	Gravitational acceleration at surface of the earth.  (FT/SEC <sup>2</sup> )	/GLOBAL/(		ACCEL IBLS I BEST I BES	GR G G G G G G G G G G G G G G G G G G
I CONVR		1	A seven word array not used.	/GLOBAL/(	96)	PADS1 1	ICONVR
ÍD		D	A four mord array containing the basic deck, reference run, case and part case numbers in that order.	/6LOBAL/( 	21)	BLICO I FRENCH I GEINP I PADSI I PRINT I SDIHP I TOPM I VEHOF I	10 10 10 10 10
IFATAL	*,	I,	Fatal error flag.	/GLOBAL/(	17)	BLICO F GEINP ( PADS1 ) SDINP F SPLICO F STPIT ( TOPM )	IFATAL IFATAL IFATAL IFATAL
IFLOP		ы	Q L convergance failure counter	/PAD51:/(#	)	PADS1	IFLOP
KSOL .		0	An internal flag that has the same significance as ITPSO.	/GLOBAL/(	94)	FNTS 1 PADS1 (C SDINP (	KSOL
LUM		M	Program control flag.  LUM = 0: Steepest descent only;  LUM = 1: Steepest descent and adjoint  transformation stored on tape;  LUM = 2: Steepest descent and QL;  LUM = 3: QL only.	/GLOBAL/(	6)	SDINP 1	LUM LUM
PI	π	0	Constant 3.1415926 <b>53</b>	/DATA /(	1)	OUT I	_ =

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FORTRAN SYMBOL	MATH Symbol	CODE	DESCRIPTION	STOR: BLOCK	AGE LOC	SUBROUTIN Suba cod	
2 4 4 4 6 C	3111006	· · · · · · · · · · · · · · · · · · ·		BLUCK	100	300K C00	C VAN
RĄD		0 Redi≥n t	o angle conversion, 57.29577951	/DATA /6		BEROCO I BLGCON I ENVPRM I EQUAS I FNTG I GUISA I MODELA I MTXSA I OUT I	DEG RAD RAD RAD RAD RAB RAB RAD RAD
		•	•	•	•	PADS1 D SDINP I TRTOSZ I	RAD RAD RAD
ROI		D Angle to	radian conversion, .01745329252	/DATA /	33	BLICO I DERSA I FNTE GUISA I MODELA I MODELB I PADSI D PROPB I PROPIN I REUS I SOMG I	RDI RDI RDI RDI RDI RDI RDI RDI RDI RDI
SC		D Constant	in Sutherlands equation, 198	/DATA /(	4)	PADS1 D PAT63 I	SC SC
TMPF		D Constant	in Sutherlands equation, 392	/DATA /	( 6)	PADS1 D PAT63 I	TMPF-
TZDD		D Booster	liftoff seight (lb)	/SIZING/	1)	PADS1 D SIZIN I TAMPER O	TZDD TZ TZ
UMF		D Constant .301x10	in Sutherlands equation, 6	/DATA /	( 5)	PADS1 D PAT63 I.	UMF UMUF

FORTRAN Symbol	MATH Symbol	CODE	DESCRIPTION	STORAGI BLOCK	LOC	SUBROUT SUBR C	INE USAGE ODE VAR
CAR		D	Constant, 1715.4027	/DATA /(	8)	PADS1	D CAR
ER	E <sub>R</sub>	. 1	Earth radius. (FT)	/SLOBAL/(		COORDS CRASH EQUA3 GEINP PADS1	I ER I REA I ER I ER I ER I ER
FTNA		Ø	Feet to nout. mi. conversion, 1.645791629x10 <sup>-4</sup>	/DATA /(	7)		I FTHA D FTHA I FTHA
GM	GM	0	Product of Hepton's universal gravitational constant and the wass of the earth. $(\text{FT}^3/\text{SEC}^2)$	/GLOBAL/(	67)	DUT PADS1	I 6M I 6M O 6M I 6M
GR <sub>1</sub>	g.		Gravitational acceleration at surface of the earth.  (FT/SEC <sup>2</sup> )	/6L0BAL/(	1)	BL5 EQUA3 FH3 GEIMP GEIMP GEIMP OUT PADS1 POBC REU3 SOIMP SIZE	I GR
						SIZ2 SIZ3 SIZ4 SOME	I GR I GR I GR I GR I GR
1 CONYR		I	A seven word array not used.	/GLOBAL/(	96)	PADS1	I CONVR
10		D	A four mord array containing the basic deck, reference run, case and part case mumbers in that order.	/GLOBAL/(	21)	FRENCH GEINP PADS1 PRINT SOINP TOPR	
IFATAL		I	Fatal error flog.	/GLOBAL/(	17)	SEINP PADS1 SDINP SPLICD STPIT	TIFATAL TIFATAL TIFATAL TIFATAL TIFATAL TIFATAL TIFATAL TIFATAL
I FLOP		님	Q L convergance fallure counter .	/PAD51 /(*	3	PADS1	# IFLOP
I PAȘS		M	Sizing iteration counter .	/\$1Z1NG/(	291)	PABS1   PAY02 SIZE   SIZIN	IPASS IPASS IPASS IPASS IPASS IPASS
JTYP		I	Sizing. Flag.	/SIZING/(	313)		977L 977L 977L
KSOŁ / 8 NOV 72 G.O	1-46	0	An Internal flag that has the same significance as IIPSO.	/GLOBAL/C	94)	FNTS I PADS1 ( SDINP (	

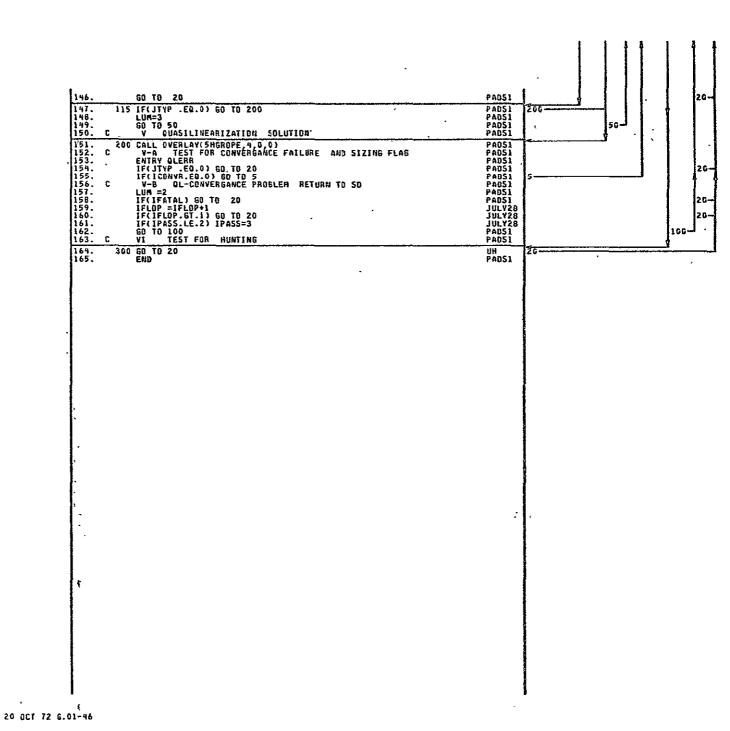
FORTRAN Symbol	MATH Symbol	COOE DESCRIPTION.	STORAGE Block Loc	SUBROUTINE USAGE SUBR CODE VAR
LUM		Program control flag.  LUM = 0: Steepest descent only;  LUM = 1: Steepest descent and adjoint  transformation stored on tape;  LUM = 2: Steepest descent and QL;  LUM = 3: QL only.	/GLOBÀL/I· &	) AST3 I LUM FATG I LUM GEIMP I LUM- PADSI M LUM SDIMP I LUM TDPM M LUM
PI	ਬ	D Constant 3.141592653	/DATA /( 1	) OUT I PI PAUSI D PI
RAD		O Radian to angle conversion, 57.29577951	. '/DATA /( 2	BEROCO I OEG . BLGCON I RAD ENVERM I RAD EQUAS I RAD - FNTG I RAD GUISA I RAD MODELA I RAD MODELA I RAD MTXSA I RAD OUT I RAD PADSI D RAD SDIMP I RAD TRTOSZ I RAD
RDI		D Angle to radian conversion, .01745329252	/DATA /L 3	DELICO I RDI DERSA I RDI FATE I RDI GUISA I RDI MODELA I RDI MODELB I RDI PADSI D RDI PROPBI I RDI PROPBI I RDI REUS I RDI SDINP I RDI SDINP I RDI
sc		D Constant in Sutherlands equation, 198	/DATA /( 4	) PAD51 D SC PAT63 I SC
TRPF		O Constant in Sutherlands equation, 392	/DATA /( 6	PADS1 D TAPF PAT63 I TF
TRAFLG		1 Traffic control flag O. Sizing loop not conve 1. Sizing loop converged 2. Error in sizing next case		) FRENCH O TRAFLS ITERS O TRAFLS PADS1 I TRAFLS SIZE M TRAFLS SSSP O TRAFLS VEHOF O TRAFLS
UAF		D Constant in Sutherlands equation, .301=10 <sup>-6</sup>	/DATA /( 5	PADSI D URF PAT63 I URUF

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SUBROUTINE PADS1
DIMENSION IIN(10), IFET(170), I39(20), I40(20), I41(60), I9(24),
#IBLKN(3), I33(182), I34(1823, I35(182)
- I34(182), I34(1823, I35(182))
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*MDB ,CGR ,ZC
*DREF ,MCND ,RH
*FRATE ,ARCD(9)
DIMENSION ARCDA(40)
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                                                                                                     * SINDMU THT , WIFUEL COMMON/GLOBAL, AMPRIL COMMON/GLOBAL, AMPRIL COMMON/GLOBAL, AMPRIL COMMON/GLOBAL, AMPRIL COMMON/GLOBAL, AMPRIL COMMON/GLOBAL, AMPRIL COMMON AMPRIL COMMON AMPRIL COMMON CO
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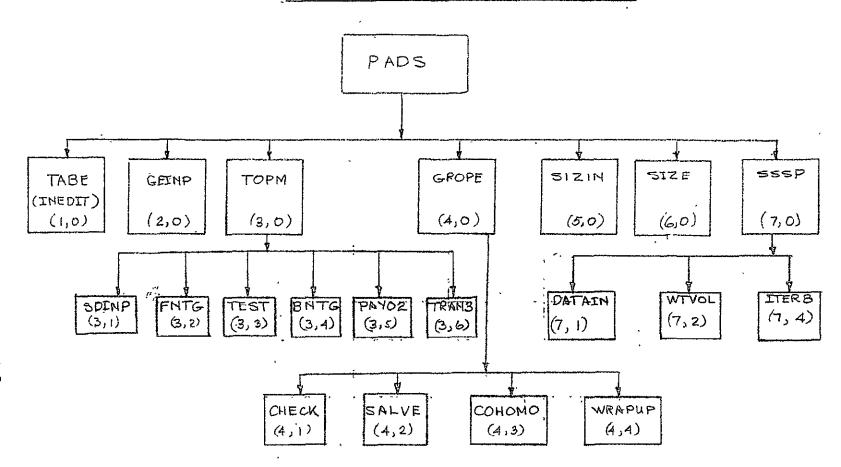
20 DCT 72 6.01-46

76. 17. 78. 19.	* SVOPSO , SVOCON , I HUNT , I OPSTG , ISZO(19) DI HENSION T ZDOCIO; I COMMON/POWEL/ ITZLE(156) EQUIVALENCE(TZDD,TZ)	UH PADSI OPTSTS PADSI						
86. 81. 82. C 83. C 84. C	GATA TZDD/101*0/ DIMENSION PT(5) MAIN PROGRAM FOR PADS -NASA MOUSTOU WRITTEN BY MCDDANGLL-DOUGLAS ASTRONAUTICS COMPANY MUNTINGTON BEACH CALIFORNIA 1972	PADS1 PADS1 PADS1 PADS1						
85. C 86. C 87.	I SET-UP STORAGE FILES COMMON/TABLE/ TABLE(2100)	PADS1 PADS1 PADS1						
88. 89. 90. <del>9</del> 1.	COMMON/LASTAD/ LASTAB, IPCT(33), IPPHTR, HTAPE, HAXPCT, BLANK DATA ID / 4*0 / DATA IPPHTR, HTAPE, BLANK, HAXPCT / 0,1,4H ,33 / IIN(1) =6LTAPE39	AAA PAOS1 AAA PADS1						
92. 93. 94. 95.	IIN(2) =6LTAPE40 IIN(3) =6LTAPE41 IIN(4) =6LTAPE11 IIN(5)=6LTAPE36	PADS1 PADS1 PADS1 POW						
96 97. 98.	IIN(6) =5LTAPE9 IIN(7)=6LTAPE33 IIN(8)=6LTAPE34 IIN(9)=6LTAPE35	PADS1 PADS1 PADS1 PADS1						
00. 01. 02. 03.	IIN 10 = 51 TAPE3 CALL EQUBUFF(51 HPUT, 10, 11 H, 1FET, 1EF) 1F(1EF.EQ.0) GO TO 10 CALL STPIT(88)	PADS1 PADS1 PADS1 PADS1	10					
74. 75. 76.	1.0 CONTINUE	PADS1 PADS1 PADS1	<b>L</b>					
7. 08. 09.	CALL DPENMS(33,133,182,0) CALL DPENMS(34,134,182,0) CALL DPENMS(35,135,182,0) CALL DPENMS(36,136,182,0) CALL DPENMS(36,136,182,0) CALL DPENMS(36,136,282,0) CALL DPENMS(36,130,20,0)	PADS1 POM PADS1 PADS1	,					
11. 12. 13. 14.	CALL OPENMS(41,141,60,0) CALL OPENMS(9,19,22,0) CALL OPENMS(3,PT,5,0) IBLKN(1)=1	PADSI PADSI AAA PADSI						
15. 16. 17. 18.	IBLKN(2)=12 IBLKN(3)=4 CALL FTNBIN(1,3,16LKH) CALL DVERLAY(4NTABI,1,0,0)	PADS1 PADS1 PADS1 PADS1						
19. 20. 21. C	20 CALL DVERLAY(48SEIN,2,0,0) GR=GR*ER*ER II TEST FOR SIZING	PADS1 PADS1 PADS1	e					
22. 23. 24.	IFLOP =0 IF(JTYP .EQ.0) 60 TO 100 5 60 TO (11.21),JTYP	JULY28 PADS1 PADS1	100			7		1
25. 26.	11 CALL DVERLAY(4HPH51,6,0,0) GD TD 50	PADS1 PADS1		50	<del></del>			
27. 28.	ZI CALL OVERLAY(4MSSSP,7,0,0) ENTRY SIZERR	PAGS1	2	<u> </u>	<u>.</u>			
29. 30. C	50 IF(TRAFLG-1.) 51 300,20 III SET-UP DATA FOR TRAJECTORY 51 CALL OVERLAY(SHSIZIN ,5,0,0)	UH PADS1 PADS1	יין ביין ביין ביין ביין ביין ביין ביין		1.	300-	]	20-
32. C 33. 34. C	IV OL OR SD TRAJÉCÍGŘÝ IF(LUM-2) 60,80,100 IV-A STEEPEST DESCENT SIZING	PADS1 PABS1 PABS1	60-60-	7			100-	1
35. 36. 37. C	60 LUM =1 60 TO 100 1V-B QL ALL THE WAY TEST FOR FIRST SIZING PASS	PADS1 PADS1 PADS1		<u> </u>			100-	١,
38. 39. C	86 IF(IPASS-2) 100,100,200 IV-C STEEPEST DESCENT TRAJECTORY 100 CALL OVERLAY(SHITOPM,3,0,0)	PADS1 PADS1 PADS1	200		1	<u> </u>	100-	1
41. 42. 43.	ENTRY SDERR KSOL=1 IF(IFATAL) SO TO 20 IF(LUM -2) 110, 115,200	PADS1 PADS1 PADS1 PADS1	110	15 266			ľ	20-
44.				., 1-44-				

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## PADS OVERLAY STRUCTURE



# BLØCK ARCDAT

ORTRAN	MATH	DESCRIPTION		STORA		SUBROUTIN	
ZAURÓF.	. SYMBOL	DECOULT	<del></del>	BLOCK	LOC	SUBR COL	DE VAR
SREF	5 <sub>ref</sub>	Aerodynamic reference area	(FT <sup>2</sup> )	/ARCDAT/(	1)	BNTG I EQUAS I FNTG I FXOAT I FXOAT O GEINP M SOINP I SIZIN M THRUST I VT I	AR CDA SREFA AR CDA I AR CDA AR CDA AR CDA SREF SREF
EJ	A <sub>exit</sub>	Nozzle exit orea	(FT <sup>2</sup> )	/ARCDAT/(	2)	PROPB I PROPIN I SIZIN O	E) E)
XISP	Isp	Vacuum specific inpulse	(SEC)	/ARCDAT/(	. 3)	IMPUL I SIZIN O	XISP- XISP
TMULT	T <sub>euit</sub>	Thrust multiplier or number of engines		/ARCDAT/(	4)	EQUAS I FXOAT M PROPB I PROPIN I SIZIN O	TMULT TMULT TMULT TMULT TMULT
BTNC	Δτ	Integration interval .	(SEC)	/ARCDAT/(	- 5}	BNTG I FNTG I GEINP M PROPLIN I	DTNC DTNC DTNC DTNC -
ртрі		Print frequency for trajectory.		/ARCDAT/(	6)	FNTG I GEINP M	DTPI DTPI
jatm		Atmosphere option flag		/ARCDAT/(	7)	EQUAS I FXDAT I OUT I PDBC I VT I	MTAI MTAI MTAI MTAI
IMOD		Control mode option flag		/ARCDAT/6	8)	FXDAT M SDINP I	IMODE
JAER		Aeradynamic model option flag	•	/ARCDAT/(	9)	BEROCO I EQUAS I GEINP I OUT I PROPB I PROPIN I VT I	JAER JAER JAER JAER JAER JAER JAER
JPRO		Propulsion model option flag		/ARCDAT/		EQUAS I SEINP I IMPUL I MODELA I 'PROPB I PROPIN I	JPR0 JPR0 JPR0 JPR0 JPR0 JPR0
MAX	Y <sub>nax</sub>	Maximum dynamic pressure instantaneous inequality limit	(PSF)	/ARCDAT/(		PROPB I	QMAX.
<b>G</b> ∕¶ <b>Ą</b> X	G <sub>max</sub>	Maximum total acceleration g load		/ARCDAT/(		BL5. I FH3 I MODELA I PROPB I	GMAX SMAX SMAX GMAX
XLAMX		Aaximum aerodynamic lift .	(LBS)	/ARCDAT/(	-	PROPIN'I MODELA I	GMAX XLMAX
HOMAX	L <sub>max</sub>	Maximum heating rate inequality constraint	,	/ARCDAT/(		PROPS I	номах
SMDOT .	Q <sub>mA</sub> X >∗	7	G/SEC)	/ARCDAT/(	15)	DER3A I MODELA I MODELB I PROPEN I	GMDOT TOOMD TOOMD TOOMD TOOMD

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ORTRAN	MATH	DESCRIPTION		STORA		<u> </u>		
SYMBOL	SYMBOL	DESCRIPTION		BLOCK	LOC	SUBR	CODE	RAV
ALFMAX .	<sup>Q</sup> MAX	Maximum angle of attack	. (DEG)	/ARCDAT/(	16)	INBVAD MODELA MODELB	Ī	ALFMA) ALFMA) ALFMA)
PHMAX		Belly down flog		)\TAGDRA\	17)			
RAEA	•	Curve number		/ARCDAT/(	18)	EQUA3 GEINP PROPB	I	MAEA MAEA MAEA
ŕ	•	•		• '	-	PROPIN		MAEA
14EB		Curve number		/ARCDAT/(	19)	EQUA3	I	MAEB
BAEC		Cyrve nyaber	-	/ARCDAT/(	20)	EQUA3	1	MAEC
HED		Curve number		/ARCDAT/(	21)	EQUAS	I	MAED
IAEĘ		Curve number		/ARCDAT/(	22)	EBUA3	1	MAEE
IĄEF		Curve number	•	/ARCDAT/(	23)	EQUA3	I	MAEF
IAEG		Curve number		/ARCDAT/(	. 24)	EOUA3	-I	MAEG
17		Curve number -thrust table -		/ARCDAT/(	25)	FXDAT PROPB PROPIN THRUST	I	AT AT AT AT
115P		Curve number kISP loss table		/ARCBAT/(	26)	IMPUL PROPB	I	MISP MISP MISP
1AXCG		Curve number -xcg table		/ARCDAT/(	27)	EQUA3	I	MXCG
1206		Curve number- zcg table	•	/ARCDAT/(	28)	EQUA3	E	MZCG
IWOB		Description not input		/ARCDAT/(	30 }	BLICO GEINP PROPB PROPIN	I	MWD8 MWD8 MWD8 MWDB
108		Curve number - base drag table		/ARCDAT/(	31)	EQUA3		MBB
CGR	X <sub>CGR</sub>	· Reference xcg location	(FT)	/ARCDAT/(	32)	VT.	1	XCGR
CGR	Z <sub>CGR</sub>	Reference zeg location	(FT)	/ARCDAT/(	33)	VT	I	ZCGR
ε "	χE	Engine thrust centroid body x station		/ARCDAT/(	347	.EL2	ſ	ΧE
ε .	ZE	Èngine thrust centroid body z station '		/ARCDAT/(	35)	AL.		ZE ZE
7	X <sub>T</sub> .	-Aerodynamic trio surface body x station		/ARCDAT/(	367)	VT .	I	XT .
REF .	D <sub>ref</sub>	Aerodynamic reference length		/ARCDAT/(	37)	٧T	i	DREF
нов	Pb	Atmosphere base density for heating calculation (LB/	FT+#3)	/ARCDAT/(		DER3A 'FXDAT PDY3A	0	RHOB ' RHOB RHOB
MULT	=0 0R 1	Heating flag multiplier		/ARCDAT/(	40)	DER3A FXDAT PDY3A	้อิ	OMULT OMULT OMULT
EMAX	R <sub>eymax</sub>	Maximum unit reynolds number inequality constrai	nt	/ARCDAT/(	41)	PROPB	1	REMAX
RATE		Input rated vacuum thrust per engine	(LBS)	/ARCDAT/(	42)	PROPB PROPIN	I -I ,	FRATE FRATE FRATE FRATE FRATE

# BLØCK BICUBE

	SYMBOL	DESCRIPTION	STORA' BLOCK	LOC	5088		USA VA
YMBOL	3111000		, , , , , , , , , , , , , , , , , , ,		~~~~	-	
AMIN	×o	The smallest value of the first Independent variable of a bivariate table.	/81¢U8E/(	, 11	BLICO BLYNE INBVAD	M I I	MMIN AMIN AMIN
XAMAX	×N	The largest value of the first independent variable of a bivariate table.	/#ICUBE/(	2)	BLICO BLYNE INBVAD	0 1 1	MMA) AMA AMA
LF.		Last file in the grid in which interpolation occurred.	\BI CUBE/(	3)	BLYNE INBVAD		IF IF
FMAX	N	Total number of files in grid.	/BICUBE/(	4)	BLICO BLYNE INBVAD	1	IRMA IFMA IFMA
MIN .	y <sub>O</sub>	The smallest value of the second independent variable of a bivariate table.	\BICUBE\(	5 ).	BLICO BLYNE	O I	AMI#
XAME	y 14	The largest value of the second independent variable of a bivariate table.	/BICUBE/(	6)	BLICO BLYNE	0 1	AMA)
[ R		Last rank in the grid in phich interpolation occurred.	/BICUBE/(	7)	BLICO BLYNE INBVAD	M M M	IF IR IR
RMAX		Total number of ranks in grid.	\BICUBE\(	8)	BLICO BLYNE INBVAD	I	IFM IRM IRM
LUNIT		Logical unit number on which bicubic spline coefficients are stored for this table.	/BICUBE/(	9)	BLICO BLYNE INGVAD	M	IUN IUN IUN
RECT		Grid rectangle associated with IR and IF.	/BICUBE/(	10)	BLICO BLYNE INBVAD	rs rs	IRE IRE
REC		Logical record on IUNIT that contains spline coefficients for rectangle IRECT.	\BICNBÉ\(	11)	BLICO BLYNE INBVAD	M M	IRE IRE IRE
<b>S</b>		A 32 word array containing the spline coefficients for the two bivariate functions at rectangle IRECT.	/BICUBE/(	12)	BLYNE BLYNE INBVAD	0 I	C CLO
CL10		Description not input	/BICUBE/(	13)	BLYNE	I	CLI
£20		Description not input	/BICUBE/(	14)	BLYNE	1	CL2
:L30		Description not input	/BICUBE/(	15)	BLYNE	1	CL3
:L01		Description not input	/BICUBE/(	16)	BLYŅĒ	I	CLO
EH		Description not input	/BICUBE/(	17)	BLYNE	4	CL1
L21		Description not input	/BICUBE/(	18)	BLYNE	I	CLZ
:L31		Description not input	/BICUBE/(	19)	BLYNE	1	CL3
CL02		Description not input	/8ICUBE/(	20)	BLYNE	1	CLO
CL12		Description not input	/BICUBE/(	21)	BLYNE	1	CL1
L22		Description not input	/8ICU8E/(	22)	BLYNE	I	CL2
CL32		Description not imput	/BICUBE/(	23)	BLYNE	ī	CL3
CL03		Description not input	/BICUBE/(		BLYNE	I	CLO
CL13		Description not input	/81 CUBE/(		BLYNE	1	CL1
L23		Description not input	/BICUBE/(		BLYNE	1	CL2
L33		Bescription not input	/B1CUBE/C		BLYNE	1	CL3
000		Description not input	/BICUBE/(		BLYNE	I	CĐO
D10		Description not Input	/BICUBE/(		BLYNE	I	CDI
:020		Description not input	/BICUBE/(		BLYNE	Ī	CD2
030		Description not input	/BICUBE/(		BLYNE	ī	CD3
001		Description not input	/81CUBE/(		BLYNE	i	CDO
D11		Description not Input	/81 CUBE/(		BLYNE	I	CBI
		Description not input	/BICUBE/(		BLYNE	I	CD2
CD21							

FORTRAN Symbol	MATH Symbol -	•	DESCRIPTION	S TORAT BLOCK	LOC	<u>5 ปลหอบ</u> 5 ปลห		USAGE VAR
<del></del>								
CD02		Description not	Input	ABICAGE\(	36)	BLYNE	I	C002
C012		Description not	input	/BİCUBE/(	37)	BLYNE	1	C012
CD22	•	Description not	Input	/81CU8E/(	38)	BLYNE	1	CD22
CD32		Description not	input	- /81CUBE/(	393	BLYNE	I	CD32
CDO3		Description not	input	/BICUBE/(	40)	BLYNE	I	CB03
C013		Description not	input	/BICUBE/(	41)	BLYNE	1	CD13
CD23		Description not	input	/BICUBE/(	42)	BLYNE	I	CD23
CD33		Description not	Input ·	/BICUBE/(	43)	BLYNE	. I	CD33
T		A 160 word arra	y containing logical record IREC.	/BICU8E/(	44)	BLICO BLYNE INBVAC	I I	T T T
ALFA		A 31 word array	containing the mesh x <sub>0</sub> , x <sub>1</sub> ,,x <sub>n</sub>	/BICUBE/(	204)	BLICO BLICO BLYNE	I M I	F Mach Alfa
MACH		A 31 mord array	containing the mesh yo, yı,,yn	\BICABE\(	235)	BLYNE	M	ALFA Mach

# BLØCK GLØBAL

FORTRAN Symbol	MATH SYMBOL	DESCRIPTION		STORAGE BLOCK LOC		SUBROUTINE USAGE SUBR CODE VAR		
`GR	g r	Gravitational acceleration at surface of the	e earth. (FT/SEC <sup>2</sup> )	/GLOBAL/(	1)	ACC5 A3 BLOUB ABLOUP BEH3 NPP GELINP PADSI		65666666666666666666666666666666666666
ER	E <sub>R</sub>	Earth radius.	(FT)	/GLOBAL/(	2)	COORDS CRASH EQUAS SEINP PADS1 POBC SOME TRTOSZ	I I I I I	ER REM ER ER ER ER ER
ÓWGZ	ω	Earth rotation rate	(RAD/SEC)	/GLOBAL/(	3)	ADID3A CRASH DER3A EQUA3 GEINP MODELA MODELB PDBC PDBC PDBC PDY3A SOINP TOPM	I I I I	OMGZ OMGZ OMGZ OMGZ OMGZ OMGZ OMGZ OMGZ
XLAMRF	Pr	Reference latitude.	(DEG)	/GLOBAL/(	4)	CRASH GEINP REU3. SDINP	M I I M	RHOO 'XLAMRF XLAMRF XLAMRF
YMURF	$\mu_{\mathbf{r}}$	Reference longitude.	(DEG)	/GLOBAL/(	5)	CRASH GEINP REU3	A I I M	UMUO YMURF YMURF YMURF
LUM		Program control flag.  LUM = 0: Steepest descent unly;  LUM = 1: Steepest descent and adjoint transformation stored on tape;  LUM = 2: Steepest descent and OL;  LUM = 3: QL only.		/GLDBAL/(	6)	AST3 FNTG	I I I N I	LUM LUM LUM LUM LUM LUM
TO	t <sub>0</sub>	Trajectory start time.	(SEC)	/GLOBAL/(	7)	SDINP	Đ	TINIT
EPSLON INNER ITRMAX JJOP DONE IFATAL	€	QL iteration convergence criterion. Number of Adams. Moulton inner loops. Maximum number of QL iterations. A six word array used for various internal for Description not input Fatal error flag.	flags.	/GLOBAL/( /GLOBAL/( /GLOBAL/( /GLOBAL/( /GLOBAL/(			M 0 I M M	DONE IFATAL IFATAL IFATAL IFATAL IFATAL IFATAL

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ORTRAN Symbol	MATH Symbol	DESCRIPTION	STORAGE BLOCK LOC		SUBROUTINE USAG		
<del></del>	<del></del>						
NARC	N <sub>3</sub>	Number of subarcs in the problem.	/GL08AL/( -	18)	FNTG GEINP PROPIN SDINP SIZIN		NARC NARC NARC NARC NARC
NBRAN	N <sub>1</sub>	Number of the last subarc on the stem of a branch problem. If the problem is not a branch problem, then NBRAN = 0.	/GLOBAL/(	1.93	SDINP,	Đ	NBRAN
NFARC	N <sub>2</sub>	Number of the last subarc on the first branch. If the problem is not a branch problem, then NFARC = NARC.	/GLOBAL/(	20.)	SDINP	0	NFARC
		A four word array containing the basic deck, reference run, case and part case numbers in that order.	/GLOBAL/(	21)	PADS1 PRINT SDINP TOPM	I B I I	ID ID ID ID ID
TAB		A 20 word array containing the number of state target conditions specified at the end of each subarc.	/GLOBAL/(	25)	VEHDF GEINP SDINP SIZIN		ID KTAB KTAB KTAB
I TAB		A 20 word array containing the number of nonzero state initial conditions specified at the beginning of each subarc.	/GLOBAL/(	45}	GEINP SDINP SIZIN	I	ITAB ITAB ITAB
216		Payoff sign. SIG < 0: Payoff to be minimized; SIG > 0: Payoff to be maximized.	/GLOBAL/(	65)	SDINP TEST	ra I	516 516 516 516
MATTAB		Largest univariant table number in this case.	./GLQBAL/(	66)			NT NT NT
GM	GM	Product of Newton's universal gravitational constant and the wass of the earth. (FT <sup>3</sup> /SEC <sup>2</sup> )	/GLOBAL/(	67)	OUT	I I O I	6M 6M 6M 6M
PSIRF	Ψ <sub>r</sub>	Reference azimuth. ' (DEG)	/GLOBAL/(	68)	SEINP REU3 SDINP	1	PSIRF PSIRF PSIRF
IPFLG1		IPFLG1≠0 supresses print-out of velocity losses and inertial Euler angles.	76LOBAL/(	69)	FNTG OUT POBC PRINT TRTOSZ		1PFLG1 IPFLG1 IPFLG1 IPFLG1 IPFLG1
PFL62		IPFLG2≠0 supresses print-out of orbital parameters	/GLOBAL/(	70)	PRINT TRTOSZ	1 0	IPFL62
IPFL63		IPFLG3≠0 supresses print-out of ispact data. 	/GLOBAL/(	71)	OUT PRINT TRTOSZ	I	IPFLG3 IPFLG3 IPFLG3
TPFLG4		IPFLG4≠0 supresses print-out of inertial Cartesian coordinates.	/GLOBAL/( .	72)	PRINT	I	IPFL64
INEQFL		A 20 mord array that contains the code number of the state variables inequality constraint that applies on each subarc. A zero entry indicates that no SVIC applies.	/GLOBAL/(	73)	PROPB PROPIN STR3	Ħ	INEOFL INEOFL INEOFL
JP3		Description not input	/GLOBAL/(	92,)	ANLATM MODELA MODELB PAT63 PROPIN	M B I	JP3 INOF INOF JP3 INOF
ITPSO		A non zero input value indicates to the steepest descent module that the initial steering angle profiles are stored on logical unit 11.	/GLOBAL/(	93)	SDINP	I	ITPS0
KSOL		An internal flag that has the same significance as ITPSO.	/GLOBAL/(	94)	PAD\$1	Ð	KSOL KSOL KSOL

FORTRAN SYMBOL	MATH Symbol	DESCRIPTION	STORAG BLOCK		UTINE USAGE CODE VAR
INARK		Logical unit on which initial and converged arcs are stored. INARK = 11.	/global/(	95)	,
KGLOBL		A seven word array not used.	/GLOBAL/(	96) PADS1	I I CONVR

### BLØCK LASTAB

FORTRAN Symbol	MATH Symbol	DESCRIPTION	<u>519845</u> 81834	€ LŲ€	<u> </u>		E. USAGE E VAR
LASTAB		Last word index .	/LASTAB/{	1)	BLICO GEINP SOINP SPLICO TABIN		LASTAB ESTWD ESTWD LASTAB LASTAB
IPCT		Input Part case number	/LASTAB/(	2)	TABIN	FQ.	1PCT
IPPNTR		Pointer array	/LAŠTAB/(	35 )	PADS1 Tabin	D M	IPPNTR IPPNTR
NTAPE		Input tape unit = 1	/LASTAB/(	36)	PADS:	D I	NTAPE NTAPE
MAXPCT	1	Maximum number of part cases = 33	/LASTAB/(	37)	PAD51 Tabin	0 1	MAXPCT MAXPCT
BLANK		preset	/LASTAB/(	38)	PADS1 Tabin	D I	BLANK Blank

### BLØCK ØRBIT

	MAIH	DESCRIPTION		510R				E USAS
SYMBOL	SYMBOL	DESCRIPTION		BLOCK	LOL	SUBR	COD	E VAR
۸ī	v <sub>1</sub>	Inertial velocity	(FT/SEC)	/ TIBRO\	. 1)	DUT PD&C PD&C	1 1 1	VI ORBPRI VI
ORBPRM		Array of intertial and orbital boundary condit		/ORBIT /			_	
GAM1	7 <sub>1</sub>	Inertial flight path angles	(RAD)	/ORBIT /	( 2)	DUT PDBC	0	GAMI GAMI
PSII	$oldsymbol{\psi}_{,\mathbf{I}}$	Inertial ozimuth	(RAD)	/ORBIT /	( 3)	OUT PDBC	I FI	P511 P511
IUMX	$\mu_{_{ m I}}$	Inertial longitude	(DAR)	/ORB1T /	( 4)	DUT PDBC	I M-	IUMX
•	Pr	Semi-latus rectum	(FT)	/ORBIT /	( 5)	OUT PDBC	I	P P
cc	e	Orbital eccentricity		/ORBIT /	( 6)	OUT	1	ECC
AIMCL	ĭ	Orbital inclination	(RAD)	/ORBIT /	( 7)	POBC	· A	ECC AINCL
ARGP	ه م	Orbital argument of perigee	(RAD)	/ORBIT /	( 8)	PBBC	M	ARGP
AXCNDD	ດ້	Longitude of ascending node	(RAD)	/ORBIT /	9)	PDBC -	I	ARGP ASCNO
SMIMAJ	a <sub>s</sub>	Semi-major axis	(FT)	/ORBIT /	( 10)	PDBC	ß	ASCNO
APOGEE	R	Apogee radius	(FT)	ORBIT /	( 11)	PDBC	M I	SMI MA
PERGEE	R <sub>p</sub>	Perigee radius	(FT)	/ORBIT /	( 12)	PDBC OUT	O I	PERGE
ANOMLY	Р \$	True anomaly	(RAD)	/ORBIT /	13)	PDBC	1	PERGE
CAPX	X	Asymptote parameter	т	/ORBIT /	[ 14)	POBC PDBC	A O	CAPX
APY	Y	Asymptote parameter	(FT)	/ORBIT /	15)	PDBC	0	CAPY
ASYMP	Θ	Dutgoing asymptote	(RAD)	/ORBIT /	( 16)	PDBC	M	ASYMI
NERGY	E	Energy		ORBIT /	17)	0 UT	I	ENER
MNTM_	н	Momentum		/ORBIT /	18)	PDBC OUT .	I I	HANT
VIDV		Partial derivative of boundary condition		/ORBIT /	19)	PDBC PDBC PDBC	P1 F1 I	'DVID'
PO		Matrix of boundary condition partial derivative	9 S	/ORBIT /	( 19)	1 900	•	110
VIDG		Partial derivative of boundary condition		/ORBIT /		POBC	R	OVID
AIDH		Partial derivative of boundary condition		/ORBIT /	21)	PDBC	Fì	DVIDI
VIDM		Partial derivative of boundary condition		/ORBIT /	22)	PDBC	Ü	DVID
VIDPS		Partial derivative of boundary condition		/ORBIT /	23)	PDBC	M	DVID
VIDRO		Partial derivative of boundary condition		/088IT /	( 24)	PDBC	M	DVID
UMOIV		Partial derivative of boundary condition		/ORBIT /	25)	PDBC	0	DVID
GIDV		Partial derivative of boundary condition		/ORBIT /	26)	PDBC	M	Deid
GIDG		Partial derivative of boundary condition		/ORBIT /	27)	PDBC	M	0 1 2 C
GIDH		Partial derivative of boundary condition		/ORBIT /	28)	PDBC	M	DGID
GIDM		Partial derivative of boundary condition		/ORBIT /	29)	PDBC	3	061D
GIDPS		Partial derivative of boundary condition.		/ORBIT /	( 30)	PDBC	19	DGID
GIDRO		Partial derivative of boundary condition		/ORBIT /	31)	PDBC	M	DGID
GIDMU .		Partial derivative of boundary condition		/ORBIT /	32)	PDBC	0	DGID
PIDV	•	Partial derivative of boundary condition		/ORBIT /	33)	PDBC	M	DPID
		Partial derivative of boundary condition				PDBC	M	0210

ORTRAN YMBOL	MATH . Symbol	DESCRIPTION	STORAGE BLOCK LOC		CODE	US AG VAR
<u> </u>						
PIDH		Partial derivative of boundary condition	· /ORBIT /( 35	) PDBC	14	DPIOH
MOIA		Partial derivative of boundary condition	/0RB1# /( , 36	) PDBC	0	DPIO
PIDPS -	•	Partial derivative of boundary condition	/ORBIT /( 37	) POBC	M,	DP 1 01
PIDRO		Partial derivative of boundary condition	/ORBIT /C 36	) POBC	Ħ	DPŢĢ
PIDMU		Partial derivative of boundary condition	/ORBIT /( 39	)_PDBC_	Ð	OP 1 D
MIDA.		Partial derivative of boundary condition	/ORBIT /( 40	) PDBC	0.	CIMO.
MIDG		Partial derivative of boundary condition	/08BIT /( 41	) POBC	0	DMID
HGIM		Partial derivative of boundary condition	/ORBIT /( 42	) PDBC	0	DMID
MCIM		Partial derivative of boundary condition	/ORBIT /( 43	) PDBC	0	DWID
MIDPS		Partial derivative of boundary condition	/0RBIT /( 44	) PDBC	ð	DAID
MIDRO		Partial derivative of boundary condition	/ORBIT /( . 45	) PD8C	0	DAID
MIDMU		Partial derivative of boundary condition	/ORBIT /( 46	) PDBC	0	DMID
PDV		Partial derivative of boundary condition	/ORBIT /( 47	) PBBC	14	DPDV
POG		·Partial derivative of boundary condition	/ORBIT /( · 48	) PDBC	Ħ	DPBG
PDH		Partial derivative of boundary condition	/ORBIT /( 49	) PDBC	M	DPDH
PDM		Partial derivative of boundary condition	/ORBIX./€ 50	) PDBC	Đ	DPD#
PDPS		Partial derivative of boundary condition	/ORBIT /( 51	) PDBC	Ħ	OPDP
PDRO		Partial derivative of boundary condition	//ORBIT /( 52	) PDBC	19	DPDF
PDMU		Partial derivative of boundary condition	' /ORBIT /( 53	) PDBC	0	1090
ECDV - '		Partial-derivative of boundary condition	/ORBIT /( 54	) PDBC	M	DECE
ECD6		Partial derivative of boundary condition	/ORBIT /( 55	) PBBC	P	DECE
ECDH		Partial derivative of boundary condition	/ORBIT /( 56	) PDBC	Ħ	DECI
ECDA		Partial derivative of boundary condition	/08BIT /( 57	) PDBC	Ð	DECI
ECDPS		Partial derivative of boundary condition	/ORBIT /( 58	) PDBC	19	DEC
ECDRO		Partial derivative of boundary condition	/ORBIT /( 59	) PBBC	M	DECE
ECDMU		Partial derivative of boundary condition	/0RBIT /( 60	) PDBC	0	DEC
ICV		Partial derivative of boundary condition	/ORBIT /( 61	') 'PBBC	M	010
10G		Partial derivative of boundary condition	/ORBIT /( 62	) POBC	14	010
IDH		Partial derivative of boundary condition	/ORBIT /( 63	) PDBC	14	BIB
I DM `		Partial derivative of boundary condition	/0'RBIT /( 64	) PB8C	0	DID
I DPS		Partial derivative of boundary condition	/ORBIT /( 65	) POBC	M	OID
1 DRO		Partial derivative of boundary condition	/ORBIT /( 66	) POBC	15	DID
I DMU		Partial derivative of boundary condition	/ORBIT /( 67	) PDBC	0	DID
BEDV		Partial derivative of boundary condition	/ORBIT /( 68	) POBC	0	OBE
BEDG		Partial derivative of boundary condition	•	) POBC	อ	DBEI
верн		Partial derivative of boundary condition		) POBC	0	DBE
BEDM		Partial derivative of boundary condition	/ORBIT /( 71	3809 C	Đ	DBE
BEDP\$		Partial derivative of boundary condition		) PDBC	0	DBE
BEDRO		Partial derivative of boundary condition		) PBBC	0	DBE
BEDMU		Partial derivative of boundary condition		) PDBC	O	OBE:
VODV		Partial derivative of boundary condition		) PDBC	Ĝ.	OND
NODG		Partial derivative of boundary condition		) PBBC	Đ	DNO
NODH		Partial derivative of boundary condition		) PDBC	0	DNÓI
NO DM		Partial derivative of boundary condition		) POBC		DNO
NODPS		Partial derivative of boundary condition		) PDBC		DNO
ORGON	-	Partial derivative of boundary condition		) PDBC	0	DNO
NDOMU		Partial derivative of boundary condition		) PDBC	0	DNO
SMDV.		Partial derivative of boundary condition		) PDBC	M.	05M
-		· · · · · · · · · · · · · · · · · · ·			•	

ORTHAN Symbol	MATH Symbol	DESCRIPTION	STORAGE Block Loc	SUBRICODE V
			· · · · · · · · · · · · · · · · · · ·	
DSMOH		Partial derivative of boundary condition	/DRBIT /( 84)	PDBC M .DSM
OSMOM		Partial derivative of boundary condition	/ORBIT /( 85)	PDBC 0 OSM
OSMOPS		Partial derivative of boundary condition	/0RBIT /( 86)	PDBC M DSM
OSMDRO		Partial derivative of boundary condition	'/ORBIT /( 87)	PDBC M DSM
DSMDMU		Partial derivative of boundary condition	/ORBIT /( 88)	PDBC 0 DSM
DAPDV		Partial derivative of boundary condition	/ORBIT /( 89.)	PDBC 0 DAP
DAPDG		Partial derivative of boundary condition	/ORBIT /( 90)	POBC O BAP
DAPDH	•	Partial derivative of boundary condition	/OABIT /( ' 91)	PDBC O DAP
DAPDM		Partial derivative of boundary condition	/ORBIT /( 92)	PÓBC O DAP
DAPDPS	•	Partial derivative of boundary condition	/ORBIT /( .93)	PDBC D DAP
DAPDRO		Partial derivative of boundary condition	/ORBIT /( 94)	PDBC 0 DAP
DAPDMU .		Partial derivative of boundary condition	/ORBIT 7( 95-)	PDBC 0 DAP
DPEDV		Partial derivative of boundary condition	/ORBIT /( 96)	PDBC 0 DPE
DPEDG		Partial derivative of boundary condition	/DABIT /( 97)	PDBC 0 DPE
DPEDH		Partial derivative of boundary condition	/ORBIT'/( 98)	ROBC O DPE
DPEDM	•	Partial derivative of boundary condition	/98BIT /( 99)	PDBC O DPE
DPEDPS		Partial decivative of boundary condition	/ORBIT /( 100)	POBC . O OPE
OPEDRO	•	Partial derivative of boundary condition	/ORBIT, /( ,:101)	PBBC 0 -OPE
DPEDMU		Partial derivative of boundary condition	/ORBIT '/( 102)	PDBC 'O OPE
DANDV		Partial derivative of boundary condition	/DABIT /( 103)	PDBC O DAN
BANDS		Partial derivative of boundary condition	/ORBIT /( 104)	PDBC 0 - DAN
DANDH		Partial derivative of boundary condition	/ORBIT /( -105)	POBC. O DAN
DANDM		Partial derivative of boundary condition	/ORBIT /( 106)	POBC O DAN
DANDPS		Partial derivative of boundary condition	/ORBIT, /( 107)	POBC O DAN
DANDRO		Partial derivative of boundary condition	/ORBIT /( 108)	POBC O DAN
DANDMU		Partial derivative of boundary condition	/ORBIT /( 109)	PÒBC O DAN
DCXDV		Partial derivative of boundary condition	/ORBIT /( 110)	PDBC 0 DCX
DCXDG		Partial derivative of boundary condition	/ORBIT /( 111)	POBC O DEX
ОСХОН		Partial derivative of boundary condition	/ORBIT /( 112)	PDBC 0 DCX
DCXDM		Partial derivative of boundary condition	/ORBIT /( 113)	PDBC 0 DCX
DCXDPS		Partial derivative of boundary condition	/ORBIT /( 114)	POBC O DCX
DCXDRQ		Partial derivative of boundary condition	/ORBIT /( 115)	PDBC 0 DCX
DČXDMU		Partial derivative of boundary condition	/DABIT /( 116)	PDBC 0 DCX
DCYDV		Partial derivative of boundary condition	/OABIT /( 117)	PDBC 0 DCY
DCYDG		Paritial derivative of boundary condition	/ORBIT /( 118)	RDBC 0 DCY
OCYDH		Partial derivative of boundary condition	/ORBIT /( 119)	POBC 0 DCY
DCYDM		Partial derivative of boundary condition	/OABIT /( 120°)	PDBC 0 DCY
DCYDPS		Partial derivative of boundary condition	/ORBIŤ /( 121)	POBC O DCY
DCYDRO		Partial derivative of boundary condition		PDBC 0 DCY
OCYDMU		Partial derivative of boundary condition		PDBC 0 DCY
DASDV		Partial derivative of boundary condition		PDBC 0 DAS
DÁSDG		Partial derivative of boundary condition		PDBC 0 DAS
DÁSDH		Partial derivative of boundary condition	/ORBIT /( 126)	POBC O DAS
DASOM		Partial derivative of boundary condition		POBC 0 DAS
BASOPS		Partial derivative of boundary condition		PDBC 0 DAS
BASDRO		Partial derivative of boundary condition		POBC 0 DAS
DASDMU		Partial derivative of boundary condition		PDBC 0 DAS
ÖENDV		Partial derivative of boundary condition		PDBC 0 DEN
		Partial derivative of boundary condition		

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FORTRAN Symbol	MATH Symbol	DESCRIPTION		STORA BLOCK	j <u>e</u> LUC	<u>504800</u> 506#		E VAR
								-, <del></del>
DENDH		Partial derivative of boundary condition		/OR81T /(	133)	PDSC	Đ	DENOH
DENDM		Partial derivative of boundary condition		/ORBIT /(	134)	P080	0	DENDA
DENDPS		Partial derivative of boundary condition		JORBIT /(	1351	POBC	. 0	DENDPS
DENDRO		Partial derivative of boundary condition		/OaBIT /(	136)	P080	0	OENDRO
DENDMU		Partial derivative of boundary condition		/ORBIT /(	. 137)	9080	. 0	DENDMU
PRODV		Partial derivative of boundary condition		/ORBIT /(	138)	2609	0	PAGGAG
อดอดกับ		Partial derivative of boundary condition		/ORBIT /	139)	POBC	ů	00000
Hacmd		Partial derivative of boundary condition		/ORBIT /(	140)	PDBC	0	DWODH
MOOMO		Partial derivative of boundary condition		/ORBIT /(	141)	2809	Đ	DMODM
0 MO DP 5		Partial derivative of boundary condition		/ORBIT /		PDBC	0	DMODPS
OMODRO		Partial derivative of boundary condition		/DABIT /(		986C	8	003080
umagma		Partial derivative of boundary condition		/DRBIT /(		POBC	Ð	อพออกเม
YMXRF	$\rho_{r}$	Reference longitude	(RAD)	. /ORBIT /(	145)	PDBC REU3	I O	YMXRF YMXRF
SNXLMR	sin(p-p <sub>r</sub> )	Sine of reference latitude		/088IT /(	146)	FOBC REU3	I 3	SNXLMR SNXLMR
CSXLMR	cos(ρ-ρ <sub>Γ</sub> )	Cosine of refernece latitude		/088IT /(	147-)	POBC REU3	ĺ	CSXLMR CSXLMR
<u>Z</u> DONM	5 <sub>0</sub>	Bown range	(FT)	/ORBIT /(	148)	OUT POBC	1	500WN 500WN.
SCROSS	Sg	Cress range	(FT)	/ORBIT /(	149;	OUT POBC	i ü	SCROSS SCROSS
TO	Ð	Down range engla	(GAS)	/ORBIT /(	1501	POBC	Ħ	TD.
TC	8 <sub>c</sub>	Cross range angle	(RAB)	/ORBIT /C	151)	PDBC	Ħ	TC
SNPSR	sin(√ <sub>F</sub> )	Sine of reference azimuth		/essit /t	152)	PDBC REU3	ĭ	SNPSR SNPSR-
CSPSR	cos(V <sub>r</sub> )	Casine of raference azimuth		/ORBIT /C	153)	PDBC REU3	10	CSPSR CSPSR
SNEI	sin(> <sub>1</sub> )	. Sine of inertial flight path angle		/088IT /(	154)	PDBC	ñ	SNGI
CSGI	cos(>T	Cosine of inertial flight path angle		/098IT /(	155)	9869	я	C5 6 I
57511	$sin(\psi_{_{\overline{1}}})$	Sin of inertial azimuth		/ORBIT /C	156)	2809	M	SPSII
CSPSII	cos(Ψ]	Cosine of Inertial zziauth		/DRBIT /C	157)	PDBC	n	CPSII
STOT	SŢ	Total range	(FT)	YORBIT /(	158)	3UT POBC TRIOSZ	1 0	STOT ' STOT STOT
CSI	cos(i)	Cosine of Inclination		/088IT /(	1591	FDBC	A	CS1
SNI	sin(i)	Sine of inclination		/ORBIT /(	160)	PBBC	m	SNI
SNGNU	sin(u)	See symbol		/ORBIT /C	161)	PDBC	Ð	SNGNU
CSAND	cos(\$)	See symbol		/ORBIT /(	152)	PDBC	Ŋ	C5ANO
20SDMU	cos(μ-μ <sub>_</sub> )	See symbol		/ORBIT /(		PDBC	r,	ดอรถสย
SINDMU	sin(μ-μ <sub>-</sub> )	See Symbol		/ORBIT /(		PDBC	n	SINDMU
THT	$\theta_{\rm T}$	Total range angle	(FT)	/ersit /(	-	PDSC	Ŋ	тит

BLØCK SIZING

	4TH 4BOL	DESCRIPTION	STORA BLOCK	GE LOC	SUBROUTI	NE USAGE DE VAR
SW		A synthesis array (20) containing counters and sizing options	/S1ZING/(	26)		
SV		A synthesis array (28) containing staging paraceters and misc flags	/S1ZING/(	46)	ENYPRM M FLYBKP I ITERS I RANGE I SIZEMR M SIZIN I SSSP I TAMPAR M TAMPER M TAMPER M TAMPER M TAMPER M TAMPER M TAMPER M TAMPER M	54 54 54 54 54 54 54 54
Sa		A synthesis data array (37,5) that contains the flyback data and some injection quantities	/S1Z1NG/(	74)	ENVPRM MFLVBKP MISFRAT I PDBC I I PDBC I I PRITVA I RANGE MEU3 O SIZEMR MSIZIN MSIZIN MSTAUDIT TAMPAR O THRUST MTTAMPER MTTAMPER MTTAMPER MUTVOL MUTVOL M	39099999999999999999999999999999999999
SE		Array of synthesis iteration propulsion parameters	/SIZING/(	259)	FLYBKP OPRITVA I SIZEMR I SUMOUT I TAMPER M THRUST I VEHDF MUTSCH I WIVOL M	SÉ
OLIM		Saved value of maximum dynamic pressure.	/SIZING/(	264)	ENVPR# #	BLIM
TLAT		Description not input	/SIZING/C		SUMOUT I	TLAT
TENG		Description not input	/S121NG/(		SUMBUT I	TLNS
<b>WB</b> C		Booster burnout weight (1b)	/51ZING/(		GEINP M PAYLOD O SIZE I SIZOUT I SIZI M SIZI M SIZZ M SIZY M	SIZ WBD DAT WBD WBD WBD WBD
WL00		Previous iteration value of booster liftoff meight (1b)	/SIZING/(	273)	SIZE. W	MEDD
DWEB		Sensitivity of booster stage meight to propellant meight (16/16)	/SIZING/(	274)	PAYLOD I SIZOUT I SIZI M SIZZ M STAU I WTORP M	DWEB DWEB DWEB DWEB DWEB
DWEC		Sensitivity of orbiter stage meight to propellant weight (lb/lb)	/SIZING/(	275)	PAYLOD I SIZOUT I SIZ1 M SIZ2 M SIZ2 M SIZ4 M	DAEO DAEO DAEO DAEO
TOLWT 8 NOV 72 6.01-4	16	Booster liftoff meight sizing tolerance (lb)	/SIZING/(	276)		TOLWT

FORTRAN MATH SYMBOL SYMBO		STORA BLOCK	EE	SUBROUTIN	
211100,0					
⊌PB <sup>°</sup> .	Booster propolismt weight (16)	/512186/(	277)	SIZOUT I SIZI M SIZZ M SIZ4 I TAMPAR I UTDRP M	. WPB WPB WPB WPB WPB
TWRAT2	Second stoge thrust-to-peight ratio	/51Z14G/( ,	278)	SIZOUT 1 SIZ1 0 SIZ2 D SIZ3 0 SIZ4 0	THRAT THRAT THRAT THRAT THRAT
BK1	Value of constant weight in booster stage meight equation	/\$1Z1#G/(	279)	SIZ1 -I SIZ2 I MTDRP I	BK1 BK1 BK1
BK2	Value of linear term coefficient in booster stage meight equation	/SIZING/¢	280)	SIZI I SIZZ I WTORP I	BK2 BK2 BK2
BK3	Value of 1/3-power term coefficient in booster stage peight equation	/SIZING/(	281)	SIZI I SIZZ I UTDRP I	BK3 BK3 BK3
844	Value of 2/3-poper tero coefficient in booster stage weight equation	/\$171#6/(	282)	SIZ1 I SIZ2 I SIDRP I	BK4 BK4 BK4
. S12E	Sizing option fing 1. Fixed slo, coxidize xpl 2. Fixed xpl, minimize slo 3. Fixed orbiter, cinimize slo 4. Fixed booster, minimize slo 5. Fixed (t/s)1.0. Maximize xpl 6. Fixed (t/s)1.0. Deterwine	/SIZING/(-	283)	SIZE M SIZOUT I	ISIZE
TRAFLE,	f Traffic control flag O. Sizing loop not converged 1. Sizing loop converged Z. Error in sizing loop next case	/SIZIHĢ/(	284}	FRENCH O ITER8 O PADSI I SIZE M SSSP O VENOF D	TRAFLI TRAFLI TRAFLI TRAFLI TRAFLI
URATO	Liftoff thrust-to-veight rotie	/SIZING/C	285)	SIZOUT 1	TURATE TURATE TURATE TURATE
OK1	Some as this except for orbiter	/SIZING/(	286)	\$121 1 \$122 1 \$124 1 UTDRP 1	8K1 8K1 8K1 8K1
3 K 2	Same as bk2 except for orbitor	/SIZING/(	2871	SIZ1 I SIZ2 I SIZ4 I WTDRP I	0K2 0K2 0K2 0K2
) K3	Same as bk3 except for orbitor	/S1ZIWG/(	288)	SIZ1 I SIZ2 I SIZ4 I WTDRP I	0K3 0K3 0K3
K4	Same as bk4 except for orbiter	/51Z1HG/(	2891	SIZI I SIZZ I SIZ4 I HTDRP I	0K4 0K4 0K4 0K4
RFLG	Sizing data print flag 1. Print header 2. Print identifier 3. Print data	/5121NG/(	290)	•	PRFLS PRFLS
PASS	Sizing Iteration counter	/S171NG/(	291)	GEINP O PADS1 M PAY02 I SIZE M SIZIN I SSSP M	IPASS IPASS IPASS IPASS IPASS IPASS

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FORTRAN	MATH	DESCRIPTION		STORAGE		INE USAG
SYMBOL.	SYMBOL	DESCRIPTION	BLOCK	FOC	SUBR C	DDE VAR
IPSMAX	•	Maximum number of iterations	/51Z1NG/(	2921		
AEXIT		Booster engine exit aros (ft##2)	/\$1Z1MG/(	293)	S171 S172 S174 S175 TAMPAR	AEXIT AEXIT AEXIT
T VACD		ürbîter wacuum thrust (16)	/SIZING/( c	294)	SIZOUT SIZI SIZZ SIZZ SIZZ SIZ4 TAMPAR	TVACO TVACO TVACO
ND		Humber of orbiter engines	/STZING/C	295)	SIZDUT I SIZI SIZZ I SIZZ I SIZZ I TAMPAB I	NO NO NO NO
		Orbiter burnout weight (ib)	/S121NG/(	296)	PAYLOD F SIZOUT 1 SIZ1 C SIZ2 C SIZ3 C SIZ4 F TAMPAR 1 TRTOSZ C	MF0 MF0 MF0 MF0 MF0 MF0
DVEL		Total ideal velocity required to orbit (fps)	/SIZING/( -	297)	SIZI I SIZ2 I SIZ3 I SIZ4 I TRTOSZ 0	IDVEL
,		Orbiter vacuum specific impulse sec	/SIZING/(	298)	SIZE P SIZOUT I SIZ1 I SIZ2 I SIZ3 I SIZ4 I TAMPAR I	15P0 15P0 15P0 15P0 15P0
SPB		Booster vecuum specific Impulse soc	/SIZING/(	299)	SIZE P SIZOUT I SIZ1 I SIZ2 I SIZ2 I SIZ4 I TAMPAR I	ISPB ISPB ISPB ISPB ISPB
PL		Payload meight (ib)	/51ZING/(		51Z0UT I 51Z1 0 51Z2 I 51Z3 I 51Z4 I TAMPAR I	XPL XPL XPL XPL
VACB		Booster vacuum thrust per engine lb	/51Z1NG/(		SIZOUT I SIZ1 I SIZ2 I SIZ4 I SIZ5 I TAMPAR I	TVACB TVACB TVACB TVACB TVACB TVACB
INB		Number of booster engines	/\$1ZING/K		SIZOUT I SIZ1 I SIZ2 I SIZ4 I SIZ5 I TAMPAR I	HMB HMB HMB HMB HMB HMB

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FORTRAN	MATH Symbol	DESCRIPTION	STORAGE Block loc	SUBBOUTINE USAGE
SYMBOL	STHOUL	<u> </u>	BLOCK LOC	SUBR CODE VAR
MEO		Orbiter stage seight (16)	/SIZI#G/( 30	31 PAYLOB I WEG SIZOUT I WEG SIZI A WEG SIZZ A WEG SIZZ I WEG SIZZ A WEG TAMPAR I WEG WITCOMP M WEG
WEB		Booster stage #olight (16)	/SIZING/( 30	H) PAYLOD I WEB SIZOUT I WEB SIZI M WEB SIZZ M WEB SIZZ I WEB TARPAR I WEB WTDRP M WED
нO		Initial orbiter seight (ib)	/51ZING/( 309	S) PAYLOD O WG SIZOUT I WO SIZOUT I WO SIZO M WO SIZO M WO SIZO M WO SIZO M WO TAMPAR I WO
#LO .		Booster liftoff weight ( b)	/SIZING/( 306	PAYLOD   WLO   SIZE     WLO   SIZE     WLO   SIZOUT   WLO   SIZ1     WLO   SIZ2     WLO   SIZ4     WLO   SIZ5     ULO   TAMPAR     WLO   ULO
046		Orbiter Ideal velocity (fps)	/SIZIN6/( 307	) SIZQUT I OVO SIZI O DVO SIZZ O DVO SIZZ M DVO SIZZ O DVO TRTOSZ O DVO
DVB		Booster idel velocity (fps)	/SIZING/( 308	) SIZOUT I DVB SIZI N DVB SIZ2 N DVB SIZ3 O DVB SIZ4 N DVB
MUB		Booster mass ratio or velocity	/SIZING/( 309	) SIZE M MUB SIZ1 I MUB SIZ2 I MUB SIZ3 M MUB SIZ4 M MUB
MUO		Orbiter mass ratio	/51Z1HG/( 310	) SIZE # MU0 SIZ1 # MU0 SIZ2 # MU0 SIZ4 * M MU0
VSTG		Booster staging velocity (fps)	/SIZING/( 311	) SIZE I VSTG TRTOSZ M VSTG
upp		Orbiter propellant weight (163	/S1.Z1NG/( 312	> SIZOUT I WPO SIZ1 M WPO SIZ2 M WPO SIZ3 I WPO SIZ4 M WPO TAMPAR I WPO TAMPAR I WPO WTORP M WPO
JTYP		Sizing. Flag.	/S1ZING/( 313	) FNTG I JTYP GEINP O JTYP MODELA I JTYP PADS1 I JTYP PAOPIN I JTYP SIZIN I JTYP TRTOSZ I JTYP
BECO 8 NOV 72 G.(	01-46	Booster cut-off arc	/51Z1NG/( 314	

FORTRAN	MATH .	DESCRIPTION	STORAG		SUBROU		
SYMBOL	SYMBOL	DESCRIFTION	BLOCK	COE	SUBR	COD	VAR
8516	•	Booster staging are	/SIIING/(	315)	SIZE VEHDF	I I	8576 8576
ORBI		Orbiter ignition are	/5121HG/(	316)	REU3 SIZE VEHDF	I 1 1	ORBI ORBI ORBI
THRE		Booster empty neght curve no.	\2151#e\	317)	SIZE SIZI SIZ2 WTORP	0 I I	HENTI HENTI HENTI HENTI HENTI
ITNOH ,		Orbiter exipty seight curve no.	\211186\(	318)	S1ZE S1Z1 S1Z2 S1Z4 UTDRP	0 1 1. 1	HONTI HONTI HONTI HONTI HONTI
SVDPSQ		Saved control matric	/SIZING/(	319)	PAYG2 TRTO5Z	10	SVDPSQ SVDPSQ
SVDCOM		Saved payoff laprovement	/S121#G/(	320)	TRTOSZ	0	SVDCOM
TAUHI		Number of iterations for parameter hunt	/5121NG/(	321)	GE1NP OPWELL SSSP	Ī	IHUNT ELIA IHUNT
102516		Description not input	/5121NG/(	322)	GEINP SIZIN SSSP	0	IOPSTG IOPSTG IOPSTG
50C0		Solld engine cut-off arc	/SIZING/(	326)	VEHOF	1 .	so`co
SOSP		Solid engine drop arc	/SIZINS/(	327)	VEHDF	1	SOSP

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### BLØCK TABLE

FORTRAM	HIAM	DESCRIPTION		ORA				USAGE
SYMBAL.	5 YMBOL	DESCRIPTION	BLOLK		LOC	SUBR	COOE	VAR
LOCI		A 50 word array that corresponds to tables 1 thru 50. Each entry is an integer that points to the initial value of the independent variable of the corresponding table. A zero entry indicates table not input.	/TABLE	K		SPLICO SPLICO SPLIZ SPLIZ SPLYNE SPLYNE THRUP	I I I	TOCI - X TOCI - X TOCI
		v.				THRUP	ο.	X
TABLE		A 2100 word array used for storing up to 50 spline fitted univariant tables.	/TABLE	16	1)			
X		A 650 word array that contains the independent variable entries of all of the 50 or less tables input.	/TABLE	/€	. 51)			
LOCL		A 50 pord array that corresponds to tables 1 thru 50. Each entry is an integer that indicates the last interval in which interpolation of the corresponding table occured.	/TABLE	70	701)	SPLICE SPLIZ SPLIZ SPLIZ SPLYNE SPLYNE THRUP	A A I I	LOCL Y LOCL Y LOCL Y Y Y
Y		A 650 gord array that contains the dependent variable entries of all of the 50 or less tables input.	/TABLE	/(	751)			
LOCF		A 50 pord array that corresponds to tables 1 thru 50. Each entry is an integer that points to the last value of the independent variable of the corresponding table.	/TABLE	/(		SPLICE SPLIZ SPLIZ SPLYNE SPLYNE THRUP	I I I	LOCF Z LOCF Z LOCF Z Z
Z'		The mesh point second derivatives of the cubic spline functions of all of the 50 or less tables input.	/TABLE	70	1451)			

# SUBRØUT INE CØØRDS

FOHIRAN SYMBOL	MATH Symbol	, cone	DESCRIPTION		STORAS BLOCK	E LOC	<u> 5 UBROU</u> 5 UBR	TINE	
ER	E <sub>R</sub>	1	Earth radius.	(FT)	/GLOBAL/(	2)	COORDS CRASH EQUA3 GEINP PADS1 POBC SOMG TRTOSZ	I I I I	ERM BR ER ER ER ER ER

```
COORDS
COORDS
COORDS
COORDS
COORDS
COORDS
                                                                                      SUBROUTINE COORDS( COSRHO,SINRHO)
SUBROUTINE TO CALCULATE INERTIAL POSITION, VELOCITY, AND EULER ANGLES FROM RELATIVE STATES.
                                                                                      DIMENSION A(9), B(9), C(9), DIRCOS(9), EULER(3)
COMMON/GLOBAL/ GÁ, ER
COMMON/PRINT/ AP(100)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            COORDS
COORDS
APRL6
COORDS
                                                                                                                  DATA INITIATION
                                                                         RAD= 1./57.29577951
PI= 3.141592653
COSA = COS(AP(29)*RAD)
SINA = SINK AP(29)*RAD)
COSBNK = COS(AP(30)*RAD)
COSBNK = COS(AP(30)*RAD)
COSGAM = COS(AP(4)*RAD)
SINGAM = SIN(AP(4)*RAD)
SINGAM = SIN(AP(4)*RAD)
SINGAM = SIN(AP(5)*RAD)
COSPSI = COS(AP(5)*RAD)
COSMUI = COS(AP(13)*RAD)
R = ER + AP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           APRL6
APRL6
COORDS
COORDS
COORDS
COORDS
COORDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             COORDS
COORDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            COORDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           COURDS
COORDS
APRL6
APRL6
COORDS
COORDS
                                                                                                                 POSITION TRANSFORMATION
                                                                                      AP(86) = R* COSRHO * COSMUI
AP(87) = R* COSRHO * SINAUI
AP(88) = R* SINANO
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            COORDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           COORDS
COORDS
COORDS
COORDS
COORDS
COORDS
COORDS
COORDS
COORDS
COORDS
                                                                                                                    VELOCITY TRANSFORMATION
                                                                         RHODOT = AP(3)/R * COSGAM* COSPSI UMIDOT = AP(3)/R * COSGAM* SIMPSI/ COSRMO RDOT = AP(3) * SINGAM AP(89) = RDOT* AP(84)/R - RHODOT* AP(88)* COSMUI 1 - UMIDOT * AP(87)/R - RHODOT* AP(88)* SINMUI 1 + UMIDOT * AP(87)/R - RHODOT* AP(88)* SINMUI 1 + UMIDOT * AP(86)* AP(91) = RDOT*SIMRHO + R*RHODOT*COSRHO
                                                                  EULER ANGLES

DB 1 1=1,9
A(1) =0.
B(1) =0.
A(1) = 1.
A(5) = 1.
A(5) = 1.
B(1) = COSA
B(3) = SINA
B(5) = 1.
B(7) = -SINA
B(7) = -SINA
B(8) = COSA
CALL PRODUT(A,B,C)
DC 2 1=1,9
B(1) = C(1)
A(1) = 1.
A(5) = COSBNK
A(6) =-SINBNK
A(8) = SINBNK
A(8) = COSBNK
A(8) = SINBNK
A(8) = COSBNK
A(8) = COSBNK
CALL PRODUT (A,B,C)
DD 3 1=1,9
B(1) = C(1)
A(1) = COSBNA
A(3) = SINBAN
A(3) = SINBAN
A(3) = SINBAN
A(4) = COSBNA
A(5) = 1.
A(7) = -SINBAN
A(9) = COSBNA
A(1) = COSBNA
A(1
                                                                                    EULER ANGLES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             COORDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             COORDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             COURDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             COORDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           APRL6
COORDS
APRL6.
COORDS
COORDS
COORDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             COORDS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             COGRES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            COORDS
COORDS
COORDS
COORDS
COORDS
COORDS
APAL6
COORDS
APAL6
COORDS
APAL6
COORDS
```

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```
DO 4 I=1,9
B(I) =C(I)
4 A(I) = 0.
A(I) = -COSPSI
A(2) = -SINPSI
A(4) = SINPSI
A(5) = -COSPSI
A(6) = 1.
CALL PRODUT(A,B,DIRCOS)
RELATIVE EULER ANGLES
                                  CALL DCTOE (DIRCOS, EULER, 1)
AP(52) = EULER(1)/AAD
AP(53) = EULER(2)/AAD
AP(54) = EULER(3)/RAD
DO 5 I=1,9
5 B(I) = 0.
B(I) = COSHUI
B(2) = SINHUI
B(4) = -SINHUI
B(5) = COSHUI
B(9) = 1
CALL PRODUT(DIRCOS, B, C)
                                                      INERTIAL EULER ANGLES
                                          CALL DCTOE(C, EULER, 1)
AF(59) = EULER(1)/RAD
AF(60) = EULER(2)/RAD
AF(61) = EULER(3)/RAD
RETURN
END
```

COORDS
COORDS
APALLO
COORDS
APALLO
COORDS

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# SUBRØUT I NE CRASH

FORTRAN Symbol •	MATH Symbol	CODE	DESCRIPTION		STORAG BLOCK	E LOC	SUBROUT!	NE USAGE
GM	GM	ī	Product of Neuton's universal gravitate constant and the mass of the earth.	ional (FT3/SEC2)	/GLOBAŁ/(	67)	CRASH 1 OUT 1 PAOS1 0 POBC 1	GM.
OMEGA	ω	I	Earth rotation rate	(RAD/SEC)	/GLOBAL/(		ADID3A I CRASH DER3A DEQUAS I GEINP MODELA I MODELA I MODELB I POBC I POBS I POBS I POBS I POBS I	OMEGA OMGZ OMGZ OMGZ OMGZ OMGZ OMGZ OMGZ
REM \$	E <sub>R</sub>	1	Earth radius.	(FT)	/GLOBAL/(	2)	COORDS I CRASH I EQUAS I GEINP I PADSI I POBC I SOMG I TRTOSZ I	REM ER ER ER ER
RH00 <sup>‡</sup>	Pr	'n	Reference latitude.	(DEG)	/GLOBAL/(	4)	CRASH F GEINP I REU3 I SDINP P	XLAMRF XLAMRF
SORT		F	Square root function (		/5 <b>0</b> RT /(\$		ANLATM F CRASH F DCTOE F DENSA F HUNT F MODELA F OPWELL F OUT F PAYOS F POPSA F STORE S SYMMAT F WISCH F	SORT SORT SORT SORT SORT SORT SORT SORT
ยพบด	$\mu_{\mathbf{r}}$	M	Reference longitude.	(DEG)	/GLOBAL/(	5)	CRASH PERSON IN SEINP PERSON P	UMUO YMURF YMURF

ORTRAN Symbol	MATH Symbol	CODE	DESCRIPTION	STORAGE Block loc	SUBROUTINE SUBR CODE	
. UNO 6.		O File o	f all output data	/.UN06./(\$	BUNGASH O O O O O O O O O O O O O O O O O O O	. U 0066. . U 0066.

```
CRASH
CRASH
CRASH
CRASH
CRASH
SUBROUTINE CRASH
                                 PADS CRASH
THIS ROUTINE PERFORMS AUXILIARY PRINT COMPUTATIONS FOR THE INSTANTEOUS IMPACT POINTS FOR AN ELLIPTICAL ORBIT ALL ANGLES IN RADIANS ALL DISTANCES IN FEET ALL TIMES IN SECONDS
            000000000
                                                                                                                                                                               CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
GLOBAL
GLOBAL
                      GLOBAL
                                                                                                                                                                                GLOBAL
GLOBAL
RETAP
CRASH
                                                                                                                                                                               CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
                                  CALCULATION OF THE FOR ELLIPTICAL ORBITS
                        FTNM = 1./6076.10333
RAD= 1./57.29577951
PI= 3.141592653
TOPI = 2. + PI
A = A/FTNM
P = P/FTNM
RIA = RIA/FTNM
RIP = RIP/FTNM
RHO = RHOO+ RAD
UMUO = UMUO+ RAD
UMUO = UMUO+ RAD
UMUO = UMUO+ RAD
UMU = UMU = RAD
UMU = UMU+ RAD
SINRP = SIN(RHO)
COSRP = COS(RHO)
                                                                                                                                                                                CRASH
CRASH
CRASH
                                                                                                                                                                                CRASH
CRASH
                                                                                                                                                                                CRASH
CRASH
                                                                                                                                                                                CRASH
CRASH
CRASH
                                                                                                                                                                                CRASH
                                                                                                                                                                                CRASH
CRASH
CRASH
                                  RADIUS
                        RI
                                        = REM + AP(2)
                                                                                                                                                                                CRASH
            CC
                                                                                                                                                                                CRASH
CRASH
CRASH
CRASH
                                 TEST FOR INTERSECTION OF ORBIT WITH EARTH
                         IF(REM.LT.RIP) GD TO 1000
IF(REM.ST.RIA) GO TO 1001
                                                                                                                                                                                                 1000-
                                                                                                                                                                                CRASH
CRASH
CRASH
CRASH
                                                                                                                                                                                                                                                             1001-
            CCC
                                  TRUE ANDMALY
                                                                                                                                                                               CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
                         COSY = ((P/RI) - 1.)/E
NUTA = ACOS(COSY)
SIHY = SIN(NUTA)
            CCC
                                   IMPACT TRUE ANDMALY (MULIP)
                         COSMUI= (P/REM -1.)/E
NUIIP= + ACOS(COSMUI)
SINNUI = SIN (HUIIP)
                                                                                                                                                                                CRASH
CRASH
CRASH
CRASH
            CCC
                                  ECCENTRIC ANOMALY
                                                                                                                                                                                CRASH
CRASH
                                                                                                                                                                               CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
                         COSED = (E + COSY)/(1.+E*COSY)
SINED = (SQRT(ABS(1.-E*E))*SINY)/(1.+E*COSY)
EC = ATAN2(SINED,COSED)
            CCC
                                   IMPACT VELOCITY (VIIP)
                          VIIP =SQRT(V+V+(GM/RI )=2.+ (RI-REM)/REM)
            C
                                   IMPACT ELEVATION FLIGHT PATH ANGLE GAMLIF
```

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```
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
                   GOSGIF = (RI+V+COS(GAMLIP
GAMLIF =- ACOS(COSGIF)
                                                                  >>/(REM+VIIP)
                           TRUE ANOMALY TO IMPACT (NUBAR- RAD)
                   NUBAR = (NUIIP -NUTA)
NUBAR = AMODINUBAR+TOPI,TOPI)
SINSB = SIN (NUBAR)
COSBD = COS(NUBAR)
                          IMPACT GEOCENTRIC LATITUDE (RH011P)
                                                                                                                                     CRASH
CRASH
CRASH
CRASH
CRASH
                   CAM21P = COS(GAM2IP)
SAM21P = SIN(GAM2IP)
SINRIP = COSRP * CAM2IP

SINRP *COSRP *COSRP

HOIIP = ASIN(SINRIP)
COSRIP = COS(RHOIIP)
                                                                        +SINBB +
                                                                                                                                     CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
                          IMPACT AZIMUTH FLIGHT PATH ANGLE (GAM21F)
                   SING2F = COSRP * SAM2IP /COSRIP
COSG2F = (COSBB*SINRIP-SINRP)/(SIMBB)*COSRIP
GAM2IF = ATAN2(SING2F,COSG2F)
GAM2IF = AMDD(GAM2IF + TOPI,TOPI)
                                                                                                                                     CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
         CCC
                          LONGITUDE FROM BURNOUT TO IMPACT - (UMUBAR)
                   SUMBAR = SINBB*SING2F/COSRIP
CUMBAR = (COSBB-SINRP*SINRIP)/(COSRP*COSRIP)
UMUBAR = ATAN2(SUMBAR, CUMBAR)
         C
                                                                                                                                     CRASH
CRASH
CRASH
CRASH
                          SIN OF THE ECCENTRIC ANDMALY (SINEF)
                   SIMEF =(SORT(ABS(1.-E+E ))+SIMBUT )/(1.+E +COSNUI)-
         CCC
                                                                                                                                     CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
                        COSINE OF ECCENTRIC ANOMALY AT IMPACT
                   COSEF = (E +COSNUI)/(1.+E+ COSNUI)
         C
                          ECCENTRIC ANOMALY AT IMPACT-EIIP
                   EIIP = ATAN2(SINEF, COSEF)
         CCC
                                                                                                                                     CRASH
CRASH
CRASH
CRASH
                          INITIAL TIME SINCE PERIGEE -TAUD
                   X = A+ SQRT(A/SM)
TAU = TOPI+X
TAUD=X+(EC -E+SIHEO)
                                          ~E*SIHE0)
                                                                                                                                     CRASH
CRASH
CRASH
         CCC
                          TIME SINCE PERIGEE AT IMPACT TAULIP
                                                                                                                                     CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
                   TAULIP = X+(ELIP -E+SINEF)
         C
C
C
                          TIME TO IMPACT -TAUBAR
                   TAUBAR = TAULIP - TAUD
IF(TAUBAR.LT.O.O) TAUBAR= TAUBAR + TAU
         CC
                          IMPACT LONGITUDE - UMULIP (DES)
                                                                                                                                     CRASH
                                                                                                                                     CRASH
CRASH
CRASH
                    UMULIP = (UMU - UMUBAR)+TAUBAR+OREGA
UMULIP = AMOD( UMULIP+ TOPI, TOPI)
         CC
                                                                                                                                      CRASH
                                                                                                                                     CRASH
CRASH
CRASH
                          IMPACT TIME -TIIP (SEC)
                   TIIP = TIME + TAUBAR
         CCC
                                                                                                                                     CRASH
CRASH
CRASH
CRASH
                         RANGE TO IMPACT SBAR (FT)
                   SBAR =REM+NUBAR
         CCC
                                                                                                                                      CRASH
                          RANGE FROM LAUNCH SITE SIIP (FT)
```

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```
X = (UMUB - UMUIIP)

SINROL = SINCRHOO)

COSROL = COSCRHOO)

SX = SINCX)

CX = COSCX)

COSX = COSCOL + COSRI

COSX = ACOSCOSX)

COSX = AROD(COSX + PI,PI)

SIIP = REM+COSX
                                                                                                                                                                                                                                                           CRASH
CRASH
CRASH
151.
152.
153.
154.
155.
156.
158.
160.
161.
163.
164.
                                                                                                                                                                                                                                                          CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
CRASH
                                                                                                  +COSRIP+CX+SINROL+SINRIP
                                                   AZIMUTH ANGLE FROM LAUNCH TO IMPACT POINT AZIIP (RAD)
                                                                                                                                                                                                                                                                                   1610
                                      IF(X.EQ.D.) 60 TO 1002
60 TO 1010
                                                                                                                                                                                                                                                                                                                           1603~
                      1002 IF(RHOIIP.LT.RHOO) 60 TO 1003
165.
                                                                                                                                                                                                                                                           CRASH
166.
167.
                      1G12 AZIIP=0.0
60 TO 1030
                                                                                                                                                                                                                                                           CRASH
CRASH
                                                                                                                                                                                                                                                                                                                                                 1030-
                     1003 AZIIP = PI
GO TO 1030
168.
169.
                                                                                                                                                                                                                                                           CRASH
                                                                                                                                                                                                                                                            CRASH
                                                                                                                                                                                                                                                                                                                                                 1036-
170.
171.
                      1010 IF(X.EQ.PI
50 TO 1020
                                                                           ) 60 TO 1011
                                                                                                                                                                                                                                                           CRASH
CRASH
                                                                                                                                                                                                                                                                                                      1020-
                      1011 IF(RHOIIP.GE.-RHOO) 60 TO 1012

60 TO 1003

1020 CONTINUE

AZIIP = ACOS((SX/ABS(SX)/SIH(SIIP/REM))

* *(COSROL*SINRIP-COSRIP*SINROL*CX))

* -((SX/ABS(SX))-1.)*PI/Z.
172
                                                                                                                                                                                                                                                           CRASH
CRASH
                                                                                                                                                                                                                                                                                                                          1612
1603
 173.
174.
175.
                                                                                                                                                                                                                                                           CRASH
176.
177.
                                                                                                                                                                                                                                                           CRASH
CRASH
                     * *(CDSROL*SINRIP-C

* -(CSY/ABS(SX))-1

1030 CDNTINUE

AP(76) = TIIP/60.

AP(77) = SIIP*FINA

AP(78) = AZIIP/ RAD

AP(81) = RHDIP/ RAD

AP(80) = SAMIIF/ RAD

AP(81) = RHDIP/ RAD

AP(81) = SAMIIF/ RAD

AP(81) = SAMIIF/ RAD

AP(81) = SAMIIF/ RAD

AP(83) = SAMA*FINA

AP(83) = SAMA*FINA

AP(85) = UMIIP/ RAD

AP(70) = TAU /60-

RHOO = RHDO/RAD

UMU = UMU /RAD

UMU = UMU /RAD

AP( = A * FTUM

RIA = RIA * FTUM

RIA = RIA * FTUM

RIA = RIA * FTUM

SAMIIP = GAMIIP/ RAD

GAMIP = GAMIP/ RAD

GAMIP = GAMIP/ RAD

GAMIP = GAMIP/ RAD

GAMIP = GAMIP/ RAD

GOTD 999

1000 CONTINUE
178.
179.
                                                                                                                                                                                                                                                           CRASH
                                                                                                                                                                                                                                                           CRASH
CRASH
CRASH
CRASH
 179.
180.
181.
182.
183.
184.
185.
                                                                                                                                                                                                                                                            CRASH
                                                                                                                                                                                                                                                            CRASH
                                                                                                                                                                                                                                                           CRASH
CRASH
CRASH
CRASH
CRASH
                                                                                                                                                                                                                                                           CRASH
CRASH
PO14
PO14
PO14
PO14
PO15
PO15
PO15
PO15
PO15
190.
191.
192.
193.
194.
195.
196.
197.
198.
200.
                                                                                                                                                                                                                                                                                    999-
                                                                                                                                                                                                                                                            CRASH
202.
203.
204.
205.
                      1000 CONTINUE
CALL PAGES(1,1,K)
WRITE(6,2)
2 FORMAT(1H,9HMO IMPACT)
60 TO 1030
                                                                                                                                                                                                                                                           CRASH
CRASH
CRASH
CRASH
 206.
                                                                                                                                                                                                                                                            APRL6
                                                                                                                                                                                                                                                                                                       1030-
                      1601 CONTINUE
CALL PAGES(1,1,K)
WRITE(6,3)
3 FORMAT(56H APOGEE ALTITUDE BELOW EARTH SURFACE)
GO TO 1030
                                                                                                                                                                                                                                                           CRASH
CRASH
CRASH
APRL6
APRL6
 207.
 208.
 210.
211.
                                                                                                                                                                                                                                                                                                       1030
                          999 RETURN
END
 212.
                                                                                                                                                                                                                                                           CRASH
CRASH
```

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# SUBRØUT I NE DCTØE

FORTRAN Symbol	MATH Symbol	COOE	DESCRIPTION		ORAGE K -ĻŪ	5088 5088		US AGI VAR
SORT		F Squár	e root function.	/SQRT	/(\$	NVPRM HUNT HODELA HODELB DPWELL DUT	***************************************	SORT SORT SORT SORT SORT SORT SORT SORT

OCTOE

```
OCTOE
OCTOE
DCTOE
DCTOE
DCTOE
DCTOE
DCTOE
DCTOE
DCTOE
DCTOE
                  SUBROUTINE OCTOECDIRCOS, EULER, KROT)
                 TRANSFORMS DIRECTION COSINES INTO EULER ANGLES
REF. SVPAT ROUTINE DCTOE
KROT.ST.O = YAH, PITCH ROLL
KROT.GT. C = PITCH, YAH, ROLL
                  DIMENSION DIRCOS(3,3) ,EULER(3)
IF(KROT) 111,111,112
                                                                                                                                          111-1112-
                        EULER ANGLES FOR ROTATION ORDER YAM, PITCH, ROLL
13.
14.
15.
16.
17.
18.
                                                                                                                             DCTOE
DCTOE
OCTOE
OCTOE
DCTOE
OCTOE
OCTOE
           111 EULER(2) = ATAN2(DIRCDS(1,2),DIRCDS(1,1))

EULER(3) = ATAN2(DIRCDS(2,3),DIRCDS(3,3))

EULER(1) = ATAN2(-DIRCDS(1,3),SART(1.- DIRCDS(1,3)+DIRCDS(1,3)))

60 TO 999
                                                                                                                                          999.
                        EULER ANGLES FOR ROTATION ORDER PITCH, YAN, ROLL
20.
21.
22.
           DCTOE
DCTOE
23.
24.
           999 RETURN
END
                                                                                                                             BCTG2
OCTGE
```

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# SUBRØUTINE INBVAD

FORTRAN	MATH	CODE	DECODIBITION '	STORA		SUBROUTIN	
SYMBOL	SYMBOL	4006	DESCRIPTION '	BLOCK	LOC	SUBR COO	E VAR
ALFMAX	α <sub>MAX</sub>	M	Maximum angle of attack (DEG)	/ARCDAT/(	16)	INBVAO M MODELA I MODELB I	ALFMAX ALFMAX ALFMAX
AMAX	x N		The largest value of the first independent variable of a bivariate table.	/BICUBE/(	2)	BLICO O BLYNE I INBVAD I	KAMM XAMA XAMA
MIMA	<sup>x</sup> o		The smallest value of the first independent variable of a bivariate table.	/BICUBE/(	1)	BLICO M BLYNE I INBVAD I	MMIN AMIN AMIN
C			A 32 word array containing the spline coefficients for the two bivariate functions at rectangle IRECT.	/BICUBE/(	12)	BLYNE B BLYNE I INBVAD O	CF00 C
15			Last file in the grid in which interpolation occurred.	/BICUBE/(	3)	BLYNE M INBVAD M	IF IF
IFMAX	N	1	Total number of files in grld.	/BICUBE/(	4)	BLICO M BLYNE I INBVAD I	IRMAX IFMAX IFMAX
IR			Last rank in the grid in which interpolation occurred.	/BICUBE/(	7)	BLICO M BLYNE M INBVAD M	IF IR IR
IREC			Logical record on IUNIT that contains spline coefficients for rectangle IRECT.	/BICUBE/(	11)	BLICO M BLYNE M INBVAD M	IREC IREC IREC
IRECT	•	Ħ	Grid rectangle associated with IR and IF.	/BICUBE/(	10)	BLICO M BLYNE M INBVAD M	IRECT IRECT IRECT
IRMAX,		1	Total number of ranks in grid.	/BICUBE/(	8)	BLICO M BLYNE I INBVAD I	IFMAX IRMAX IRMAX
IUNIT			Logical unit number on which bicubic spline coefficients are stored for this table.	/BICUBE/(	9)	BLICO M BLYNE I INBVAD I	TINUT TINUT TINUT
т		I	A 160 word array containing logical record IREC.	/BICUBEY(	44)	BLICO I BLYNE I INBVAD I	T T

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                                                     SUBROUTINE INBVADCISET)
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                        C
                                                             " INITIALIZES BIVARIATE INTERPOLATION
                                               COMMON /BICUBE/ AMIN, AMAX, IF, IFMAX, MMIN, MMAX, IR, IRMAX, ILUNIT, IRECT, IREC, C(32), T(160), F(70)
COMMON /ARCDAT/ BETA(40)
EQUIVALENCE (ALFMAX, BETA(16))
CALL READMS(ISET + 27, AMIN, 273, 1)
IF(ALFMAX .LE. 0.) ALFMAX = 3.1415926536
IF(AMIN .GT. -ALFMAX .OR. ALFMAX .GT. AMAX) STOP 11111
                                   IF(AMIN .GT. -ALFMAX .DR. ALFMAX .

1 CONTINUE
IF = (IFMAX + 1)/2
IR = (IFMAX + 1)/2
IRECT = IR + IRMAX=(IF - 1)
IREC = (IRECT - 1)/5 + 2
CALL READMS(IUNIT, T, 160, IREC)
IB = 32*(IRECT - 5=IREC + 9)
DD 10 I = 1, 32
J = I + IB
10 C(I) = T(J)
RETURN
AIRBREATHER ENTRY
ENTRY INSUPD
CALL READMS(ISET +27, AMIN, 273, 1)
ED TO I
END .
                                                                                                                                                                                                                                                                                                                                                                             FIXED
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### SUBRØUT I NE I SPRAT

#### Subroutine ISPRAT

#### Entry ISPIN

#### Purpose

Subroutine ISPRAT computes the effective ISP for the dual engine simulation associated with SSP sizing problems.

#### Description

The equations in ISPRAT are described in Section 7 of Vol I. Entry point ISPIN is called to initialize the vacuum thrust values and ISP ratio of the two engines.

FORTRAN Symbol	MATH Symbol	CODE	DESCRIPTION	STORAS BLOCK	E LOC	SUBROUT SUBR C	INE USA ODE VA
5 <b>0</b> .		I Asyı flyba	nthesis data array (37,5) that contains the ack data and some injection quantities	/S121NG/(	74)	REU3 SIZE, SIZEAR	#1117800##IFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF

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```
ISPRAT
IS
                                                                                                                            SUBROUTINE ISPRAT( TRAT, ISR, ISRT, ISRT, I)
COMPUTE MEAN ISP ÁATIÓ FOR DUAL ENGINE SIMULATION
DURING THROTTLING
LIHEN ENGINES HAVE DIFFERENT ISP VALUES
    12345678901234567
                                                                                                             UMEN ENGINES HAVE DIFFERENT ISP VALUES

HAS TWO ENTRY POINTS
ISPIN, INITIALIZES DATA AT ARC CORNER POINT
REAL ISR, ISRT, KPRIME
REAL MUB, HUD, ISPB, ISPO, IDVEL, NAB, ND
COMMON /SIZING/
PHASE II SIZING PARAMERERS
*II, W(3), AP(14), EROR, PZ(5), VG,
*SV(28), SQ(37,5), SE(1), TLAT, TLNG,
PHASE I SIZING PARAMERERS
**BO, BLOO, DNEO, DNEO, TOLLUT, NPB,
**BNO, BLOO, DNEO, DNEO, TOLLUT, NPB,
**BK1, 6%2, B%3, B%4, ISIZE, TRAFLG,
**OK1, 6%2, B%3, B%4, PRFLG, IFASS,
**AEXIT, TVACO, NO, MFO, 10VEL, ISPO,
**PPL, TVACO, NO, MFO, 10VEL, ISPO,
**PPL, TVACO, NO, MFO, WEB, NO,
**SVOPSO SVOCON, INUN, MUS, MUO, VB, MPD
**SVOPSO SVOCON, INUN, IDPSTG, ISZO(19)
**EQUIVALENCE (RV1, IV1), (RV2, TV2)
TRACE TRAT**-01
DEH = (KPRIME + TRAO -1.)**RV1 + TRAO*RV2
ISR = TRAO *(KPRIME*TV1 + TV2)/DEN
IF(1.EO.1) GO TO 103
ISRT = ISR*(-1./TRAO -(RV1+TV2)/DEN)
ISRT = ISR*(-1./TRAO -1.)*RTT

2 ISRT = 100.*ISRT
                                                    ε
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 TURATZ, SIZING
TURATZ, SIZING
TURATAX, SIZING
ISPB, SIZING
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JULY28
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ISPRAT
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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              JULY28
ISPRAT
                                                                              102 ISRT = 100.*ISRT
  32.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              ISPRAT
                                                                            103 ISR = 100.*ISR

RETURN

INITIALIZATION ENTRY

ENTRY ISPIN

TV1 IS THE UNTHROTTLE ENGINE ,TV2 IS THROTTLED THRUST(VAC)

KPRIME IS THE RATIO ISP-2 / ISP-1 (VACUUM DNLY)

TV1=SQ(31,1)

TV2=SQ(31,2)

KPRIME=SQ(31,3)

RETURN

END
33.
35. C
36. C
37. C
38. C
40.
41.
42.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              ISPRAT
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                                                                                                                                  END
```

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# MATADD

```
MAT ADD
                               SUBROUTINE MATADOCS, A, B, U, A)
1.23.45.67.89.10.11.12.13.
              000000
                               THIS SUBPROGRAM PERFORMS THE COUBLE PRECISION MATRIX ADDITION SEA+B, WHERE N IS THE NUMBER OF ROWS IN THE A (B) MATRIX AND M IS THE NUMBER OF COLUMNS IN THE A (B) MATRIX.
                               DIMENSION A(1), B(1), S(1)
                         J = N=M

DD 1 I = 1, J

1 S(I) = A(I) + B(I)

RETURN

END
```

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MATMLT

```
SUBROUTINE MATRICE, A, B, MB, W, L)
DIMENSION A(11,8(1),C(1)
L1) = RN+4
H1 = RN+2
DD 2D 1 = 1,MB
L2 = 1
DB 2D 1 = 1,MB
SUM = 0.0
DB 10 K = 1,L11,MB
SUM = SUM + A(K)=B(L2)
10 L2 = L2 + 1
24 G(1) = SUM
RETURNS
                                                                                                                                                                                                                                                                                                                                                                                                                                            MATTHLT ```

73

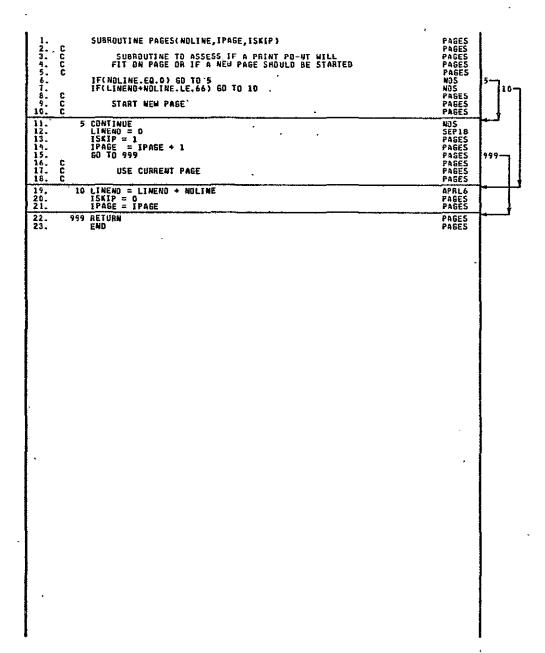
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PAGES

## Subroutine PAGES

## Purpose '

PAGES keeps track of page and line count and returns a flag to indicate when a page should be thrown. PAGES is called from print.



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# SUBRØUT I NE PAYLØD

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE DESCRIPTION                                                 | STORAGE<br>Block Lo | SUBROUTINE USAGE<br>SUBR CODE VAR                                                                                       |
|-------------------|----------------|------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------|
| DWEB              |                | I Sensitivity of booster stage meight to propella meight (lb/lb) | nt /51ZING/( 27     | 4) PAYLOD I DWEB<br>SIZOUT I DWEB<br>SIZI M DWEB<br>SIZ2 M DWEB<br>STAU I DWEB<br>WTDRP M DWEB                          |
| DWEO              |                | I Sensitivity of orbiter stage meight to propeila meight (ib/ib) | nt /SIZING/4 27     | 5) PAYLOD I DWED<br>SIZOUT I DWED<br>SIZ1 M DWED<br>SIZ2 M DWED<br>SIZ4 M DWED<br>WTDRP M DWED                          |
| MBD               |                | D Booster turnout melght (16)                                    | /51ZING/( 27        | 2) GEINP M SIZ<br>PAYLOO 0 WBO<br>SIZE I DAT<br>SIZEUT I WBO<br>SIZI M WBO<br>SIZZ M WBO<br>SIZZ M WBO<br>TAMPAR I WBO  |
| WEB               |                | i Booster stage melght (lb)                                      | /SIZING/( 30        | 4) PAYLOD I WEB<br>SIZOUT I WEB<br>SIZI M WEB<br>SIZ2 M WEB<br>SIZ4 I WEB<br>TAMPAR I WEB<br>WTORP M WEB                |
| 4ED               |                | I Orbiter stage welght (lb)                                      | /SIZING/( 30.       | 3) PAYLOD I WEO<br>SIZOUT I WEO<br>SIZI M WEO<br>SIZ2 M WEO<br>SIZ3 I WEO<br>SIZ4 M WEO<br>TAMPAR I WEO<br>MTORP M WEO  |
| af B              |                | A Orbiter burnout meight (16)                                    | /51ZING/( 29        | 5) PAYLOO M WFO<br>SIZOUT I WFO<br>SIZI O WFO<br>SIZI O WFO<br>SIZI O WFO<br>SIZI O WFO<br>TAMPAR I WFO<br>TATOSZ O WFO |
| #LO               |                | 0 Booster liftoff #eight (16)                                    | /STZING/( 30/       | S PAYLOD 0 WLD SIZE I WLO SIZE I WLO SIZOUT I WLO SIZI I WLO SIZI M WLO SIZI M WLO SIZI M WLO SIZI M WLO TAMPAR I WLO   |
| 10                |                | B Initl∌i orbiter øeight (1b)                                    | /SIZING/( 305       | ) PAYLOO O WO<br>SIZOUT I WO<br>SIZI M WO<br>SIZI M WO<br>SIZI M WO<br>SIZI M WO<br>TAMPAR I WO                         |

<sup>8</sup> NOV 72 G, 01-46

PAYLOD

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PAYLOD
PAYLOD
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PAYLOD
PAYLOD
SIZING
PAYLOD
  SUBROUTINE PAYLOB(PL, DP1, DP3, W1, W2)
CCC
   OPTIMAL STAGING OPTION PAYLOAD CALCULATIONS
  OPTIMAL STAGING OPTION PAYLOAD CALCE

REAL MUB, MUD, ISPB, ISPO, IDVEL, NNB, NO
COMMON /SIZING/
PHASE II SIZING PARAMERERS
*IZ, VV(3), OP(14), EROR, PZ
*SV(28), SQ(37,5), SE(11) TLAT, T
PHASE I SIZING PARAMERERS
*WBO, DUBO, DUBE, DUBO, T
*WBO, WLOO, DUBE, DUBO, T
*BR1, BK2, BK3, BK4, I
*OK1, OK2, OK3, OK4, P
*OK1, TVACD, NO, MFO, I
*XPL, TVACD, NNB, WEO, W
*XPL, TVACB, NNB, WEO, W
*SVPL, TVACB, NNB, MUO,
*JIVP, BECG, BSTG, ORBI, IT
*SVPPSQ, SVDCON, IHUNT, IDPSTG, IS
WD = M1
WFO = W2
WBO = M1 + WEB
WLO = VV(1)
                      C
  ٧Đ,
                      £
  DWEO, TOLWT, WPB
BK4, ISIZE, TRA
OK4, PRFLG, IPA
WFO, IDVEL, ISP
WEO, WEB, WO,
ORBI, ITMBW ITMOW
JOPSTG, ISZD(15)
   WPB,
TRAFLG,
IFASS,
ISPO,
WO,
WPO
                     CCC
  PAYLOAD MEIGHT
  PL=MF0-MED
                     000000
   PAYLOAD SENSITIVITIES TO
   1. ORBITER FINAL WEIGHT
   DP1=1.+DWED
                      000000
  2. ORBITER INITIAL WEIGHT
  3 BOOSTER FINAL WEIGHT
39.
40.
41.
42.
   DP3=-DWE0+(1.+DWEB)
                      C
  RETURN
END
```

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# SUBRØUT I NE PRINT

| FORTRAN | HTAM   | CODE | DESCRIPTION                                                                                           | DECEDIATION STORAGE |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                         | USAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------|--------|------|-------------------------------------------------------------------------------------------------------|---------------------|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL | 3000 | OE OCUTALITUM                                                                                         | BLOCK               | ioi | SUBH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CODE                                    | RAV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 10      |        | I    | A four word array containing the basic deck, reference run, case and part case numbers in that order. | /GL@BAL/(           | 21) | BLICO<br>FRENCH<br>GEINP<br>PADS1<br>PRINT<br>SDINP<br>TOPM<br>VEHDF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 111011111111111111111111111111111111111 | 10<br>10<br>10<br>10<br>10<br>10<br>10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| IPFLG1  |        | Í    | 1PFLG1≠0 supresses print-out of velocity losses and inertial Euler angles.                            | /GLOBAL/(           | 69) | FNTG<br>OUT<br>PDBC<br>PRINT<br>TRTOSZ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | I<br>I<br>I                             | IPFLG1<br>IPFLG1<br>IPFLG1<br>IPFLG1<br>IPFLG1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| IPFLG2  |        | 1    | IPFLG2#0 supresses print-out of orbital parameters.                                                   | /GLOBAL/(           | 70) | PRINT<br>TRTOSZ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | I<br>O                                  | IPFLG2<br>IPFLG2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| IPFLG3  |        | 1    | IPFLG3#0 supresses print-out of impact data.                                                          | \erobyr\(           | 71) | OUT<br>PRINT<br>TRIOSZ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                         | IPFLG3<br>IPFLG3<br>IPFLG3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| IPFLG4  |        | 1    | IPFLG4≠0 supresses print-out of inertial Cartesian coordinates.                                       | /GLOBAŁ/(           | 72) | PRINT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1                                       | IPFL64                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| .UNO6.  |        | 0    | File of ell output deta                                                                               | /.UN06./(\$         |     | BLICOYC<br>BLICAYCH<br>FRENCH<br>FRENCH<br>FRENCH<br>FRENCH<br>FRENCH<br>HUNTI<br>HITERS<br>MODAJ<br>MODAJ<br>MODAJ<br>MODAJ<br>MODAJ<br>MODAJ<br>PRINTE<br>PRINTE<br>PRINTE<br>PRINTS<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>SIZVE<br>S | 000000000000000000000000000000000000000 | . UNO 6 U |

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PRINT

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PRINT
GLOBAL
GLOBAL
GLOBAL
GLOBAL
GLOBAL
RETAP
PRINT
   SUBROUTINE PRINT(ITER, N, M, K)
                                       PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
   00000000000000
  PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
APRINT
PRINT
PRINT
PRINT
PRINT
PRINT
   IF(K NE.0) 60 TO 60
IF(N.EQ.0) 60 TO 150
  150-
   PRINT
PRINT
PRINT
FLINT
  Ç
  COUNT LINES
                                       30 C
31.
32.
33.
34.
35.
36.
37.
38. C
41.
42.
44.
   151 CONTINUE
  NOS
APRL6
PRINT
PRINT
PRINT
PAINT
   PRINT
PRINT
PRINT
  400-
   NOS
NOS
NOS
APB72
                                       HOS
   APRL6
APRL6
APRL6
APRL5
  WALTELS, 12) LT, (ALT), 1-43, 47), L8=8
WRITE(6, 12) L8, (A(I), 1-48, 54)
L9=9
L10=10
L11=11
L12=12
   APRL6
APRL6
   APIL6
  L12=12

L13=13

L14= 14

IF(IPFLG1.EQ.O) WRITE(6,12) L9 ,(A(I), I=55,61)

IF(IPFLG2.EQ.O) WRITE(6,12) L10,(A(I), I=62,68)

IF(IPFLG3.EQ.O) WRITE(6,12) L11 ,(A(I), I=69,75)

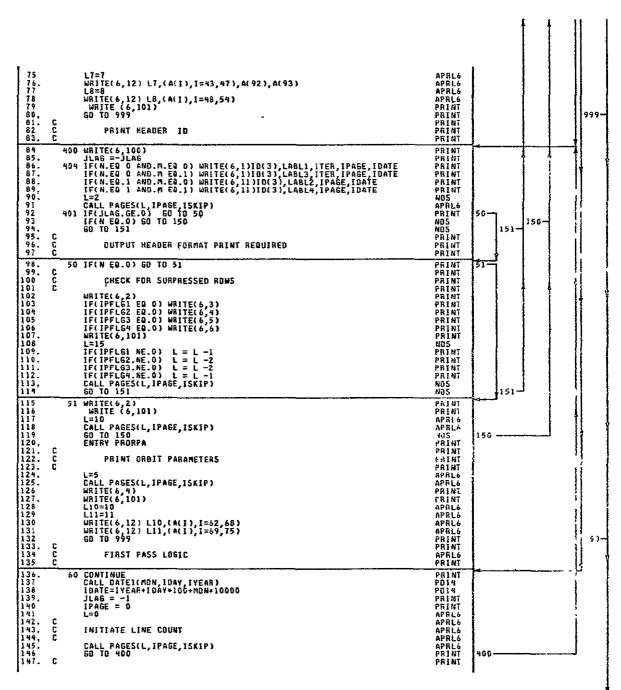
IF(IPFLG3.EQ.O) WRITE(6,15) L12,(A(I), I=76,81)

IF(IPFLG3.EQ.O) WRITE(6,15) L12,(A(I), I=82,85)

IF(IPFLG4.EQ.O) WRITE(6,15) L14,(A(I), I=82,85)

URITE (6,101)

80 TO 999
   APPL6
APRL6
APRLC
   APRT2
APRT2
APRT2
APRT2
   PRINT
PRINT
   999
  PAINT
APRIL6
PAINT
PAINT
PAINT
NOS
NOS
APR72
NOS
APR16
                                       64.
65.
66.
67.
69.
71.
72.
73.
  150 CONTINUE
   150 CONTINUE
L=10
CALL PAGES(L, IPAGE, ISKIP)
IF(ISKIP ED. 1) SO TO NOD
403 CONTINUE
KJ=0
DD 8 J=1,36,7
KJ=KJ+1
KK=J+6
WRITE(6,12) KJ,(A(I),I=J,KK)
8 CONTINUE
  100
20 açt 72 G.01-46
```



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PRINT
PRINT
PRINT
PRINT
148. CC
149. CC
151. CC
152. CC
153. 156
157. 158. 156
160. 161. 162. 163. 165. 1667. 163. 165. 167. 177. 177. 177. 177. 177. CC
  HEADER FORMAT
   1 FORMAT(1H ,5HCASE 13,7X,3A6,13,20X,6H PAGE ,13,50X,5HDATE ,19 }
11 FORMAT(1H ,5HCASE,13,7X,3A6,23X,6H PAGE ,13,50X,5HDATE ,19)
  PRINT
PRINT
PRINT
PRINT
PRINT
  SHORT HEADER FORMAT ROWS 1 THRU .
   SHURN HEADER FURMAL RUMS 1 THRU $

2 FORMAT(3H 1 ,14%,4HTIME,10%,8MALTITUDE,6%,12MREL VELOCITY,9%,
114MREL PATH ANGLE,7%,11HREL AZIMUTH,5%,13HREL LONGITUDE,10%,
28HLATITUDE/3H 2 ,10%,8HARC TIME,12%,6HNEISHT,6%,12HIMN VELOCITY,
3,4%,14HIMR PATH ANGLE,7%,11HIMR AZIMUTH,5%,13HIMR LONGITUDE,5%,
13HCHOSS RAGG (NM)/3H 3 ,8%,10HPHASE TIME,14%,4HMASS,
54%,14HIDEAL VELOCITY,
59%,5HHEAT LOAD,9%,9HEAT RATE,9%,9HRAMGE(NM),6%,12HDOWN RNG(NM)/
63H 4 ,9%,9HRE NUMBER,5%,12HAMB PRESSURE,5%,13HATNOS DENSITY,
77%,11HSPEED SOUND,7%, 11HMACH NUMBER,8%,10H0HFT COEFF,8%,
810HORAG COEFF/3H 5 ,13%,5HALPHA,8%,16H0AMK ANGLE,6%,
912HBLEND FACTOR,5%,13HDYNAMIC PRESS,7%,11HAERO MOMENT,14%,4HLIFT,
14%,4HORAG/3H 6 ,12%,6HTHHUST,7%,9HCOSTATE V,5%,13HCOSTATE GAMM 1
1A,7%,11HCOSTATE AZI,7%,11HCOSTATE ALT,7%,11HCOSTATE LAT,6%,
212HCOSTATE LONG/3H 7 ,6%,12HSPEC 1MPULSE,6%,12HCOSTATE MASS,
33%,15HCOSTATE HEATING,5%,13HCOSTATE VYYYY,7%,11HAMILTONIAN
4,5%,13HSTEERING ELEY,6%,12HSTEERING AZI/3H,31HHAMILTONIAN
4,5%,13HSTEERING ELEY,6%,12HSTEERING AZI/3H,31HHAMILTONIAN
4,5%,13HSTEERING ELEY,6%,12HSTEERING AZI/3H,31HHAMILTONIAN
4,5%,13HSTEERING ELEY,6%,19HSTEERING AZI/3H,8HREL ROLL)
   PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
   APRL6
PRINT
  PRINT
PRINT
PRINT
PRINT
PRINT
APRES
PRINT
PRINT
   PRINT
   PRINT
PRINT
   ROW 9 FORMAT
   PRINT
PRINT
PRINT
PRINT
PRINT
  3 FORMAT(1H , 2H 9,9X,9HDRAG LOSS,6X,12HGRAVITY LOSS,8X, 110HALPHA LOSS,3X,15HBACK PRESS LOSS,9X,9HINR PITCH,11X, 27HINR YAW,10X,8HINR ROLL)
   PRINT
PRINT
PRINT
PRINT
 180.

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   ROW 10 AND 11 FORMAT (ORBIT ELEMENTS)
  # FORMAT(1H, 2H10,5x,13HSEMI AXIS(NM),6x,12HECCENTRICITY,7x,
111HINCLINATION,4x,14HASCENDING NODE,7x,11HARG PERIGEE,4x,
214HAPOGEE RAD(NM),3x,15HPERIGEE RAD(NM)/3H 11,6x,
312HTRUE ANDMALY,4x,14H PERIOD(MIN),12x,6HEHERGY,10x,
4BHMOMENTUM,2x,16HSEMI LAT REC(NM),3x,15HAPOGEE VELOCITY,2x,
516HPERIGEE VELOCITY)
   PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
   ROW 12 AND 13 FORMAT (IIF)
  5 FORMAT(3H 12 ,5x,13HIMP TIME(MIN),5x,13HIMP RANGE(NM),4x,
114HAZIMUTH TO IMP,24x,12HIMP VELOCITY,4x,14HIMP PATH ANSLE,6x,
212HIMP LATITUDE/3H 13 ,2x,16HIME TO IMP(MIN),2x,
316HRANGE TO IMP(NM),55x,17HIMP AZIMUTH ANGLE,5x,13HIMP LONGITUDE)
   PRINT
   PRINT
PRINT
PRINT
PRINT
PRINT
PRINT
  ROW 14 CARTESIAN IMERTIAL COORDINATES
   6 FORMAT(3H 14 ,8X,10HCART-X 1NR,8X,10HCART-Y 1NR,8X, 10HCART-Z 1NR,23X,13HCART-XDOT 1AR,5X,13HCART-YDOT 1MR,5X, 213HCART-ZDOT 1MR)

12 FORMAT(1H ,12,7E18.7)

15 FORMAT(1H ,12,3E18.7,18X,3E18.7)

16 FORMAT(1H ,12,2E18.7,54X,2E18.7)

100 FORMAT(1H)

101 FORMAT(1HO)

14 FORMAT(1HO)

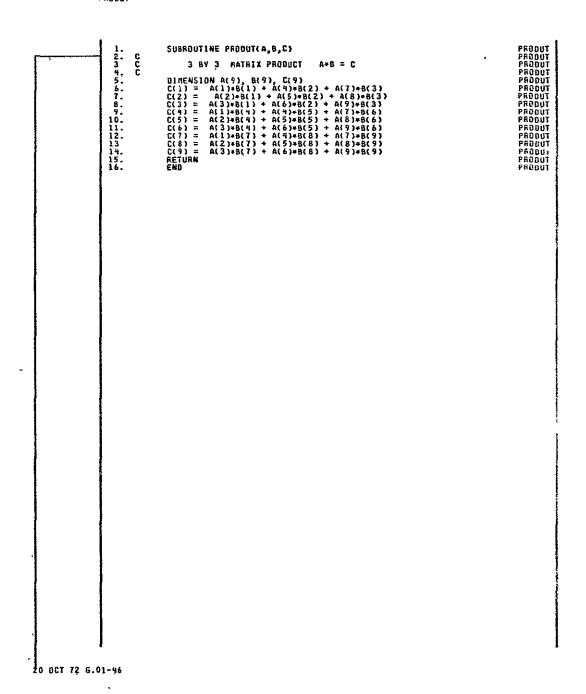
15 FORMAT(1HO)

16 FORMAT(1HO)

17 FORMAT(1HO,7E18.7)
  APRL6
   APRL6
PRINT
PRINT
    203.
204.
205.
  PRINT
    267.
208.
  999 RETURN
END
  PRINT
PRINT
```

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PRODUT



# SUBRØUT I NE SPLIZ



| FORTRAN<br>Symbol | MATH<br>Symbol | CODE                              | DESCRIPTION                                                                                                                            | STORAGE<br>Bio'r loc | SUBROUTINE USAGE<br>SUBRIOUE VAR                                                                     |
|-------------------|----------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------|
| LOCF              |                | 50. Each entry                    | that corresponds to tables 1 thru<br>is an integer that points to the<br>he independent variable of the<br>able                        | /TABLE /( 1401       | SPLICO M LOCF<br>SPLICO M Z<br>SPLIZ I LOCF<br>SPLIZ I Z<br>SPLYNE I LOCF<br>SPLYNE I Z<br>THRUP O Z |
| 1001              |                | 50 Each entry<br>initial value o  | that corresponds to tables 1 thruis an integer that points to the f the independent variable of the able A zero entry indicates table  | /TABLE /( 1          | SPLICO M LDCI SPLICO M X SPLIZ I LOCI SPLIZ I X SPLYNE I LOCI SPLYNE I X IHRUP I LOCI IHRUP O X      |
| LOCL              |                | 50 Each entry                     | that corresponds to tables 1 thru is an integer that indicates the n which interpolation of the able occured.                          | /TABLE /( 701        | SPLICO O LOCL SPLICO M Y SPLIZ M LOCL SPLIZ I Y SPLYNE M LOCL SPLYNE I Y THRUP O Y                   |
| NT                |                | I Largest univari                 | ant table nùmber in this case.<br>-                                                                                                    | /GLOBAL/( 66         | SPLICO M NT<br>SPLIZ I NT<br>SPLYNE I NT                                                             |
| x                 |                | 50. Each entrý<br>initial value o | that corresponds to tables 1 thruis an integer that points to the f the independent variable of the able. A zero entry indicates table | /TABLE /( 1          | SPLICO M LOCI SPLICO M X SPLIZ I LOCI SPLIZ I X SPLYNE I LOCI SPLYNE I X THRUP I LOCI THRUP O X      |
| ¥                 |                | 50. Each entry                    | that corresponds to tables 1 thruis an integer that indicates the numbich interpolation of the able occured.                           | /TABLE /( 701        | SPLICO O LOCL SPLICO M Y SPLIZ M LOCL SPLIZ I Y SPLYNE M LOCL SPLYNE I Y THRUP O Y                   |
| Z                 |                | 50. Each entry                    | that corresponds to tables 1 thru is an integer that points to the he independent variable of the able.                                | /TABLE /( 1401       | SPLICO M LOCF SPLICO M Z SPLIZ I LOCF SPLIZ I Z SPLYNE I LOCF SPLYNE I Z THRUP O Z                   |

SPLIZ

```
SUBROUTINE SPLIZ(IT,T,F,OFDX)
COMMON /TABLE/ TABLE(2100) /GLOBAL/ G(66)
DIMENSION X(1), Y(1), Z(1), LOCT(1), LOCT(1), LOCF(1)
EQUIVALENCE (X, TABLE), (Y, TABLE(761)), (Z, TABLE(1401)),
I(LOCI, X) (LOCL, Y), SLOCF, Z), (NT, G(66))
DATA SIXM/1715525252525252525250/
DATA SPLINT /6MSPLINE/
10 FORMAT(110, 22MTHE TABLE NO. IN LOC. 06 17M IS OUT OF RANGE.)
20 FORMAT(110, 22MTHE TABLE NO. IN LOC. 06 20H HAS NOT BEEN IMPUT.)
IF(IT .LE. NT) GO TO 30
ITLOC = XLOCF(IT)
WRITE(6,10) ITLOC
COLL STPIT (6)
  SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
1.
2.
3.
4.
5.
6
7
8.
9.
10.
11.
12.
  36-
   SPLIZ
SPLIZ
SPLIZ
                       30 IF(IT .LE. 0) 68 TO 49
I1 = LOCI(IT)
IF(II .6T. 0) 60 TO 50
ITLOC = XLOCF(IT)
WRITE(6,20) ITLOC
CALL STPIT (6)
14.
15.
16.
17.
18.
19.
   SPLIZ
SPLIZ
SPLIZ
SPLIZ
  40~
   50
   SPLIZ
SPLIZ
20.
21.
22.
                        40 F = 0.
DFDX = 0.
   SPLIZ
SPLIZ
SPLIZ
                                RETURN
23.
24
                       50 IF = LOCF(IT)
IF(IF - II - 1) 60,70,80
   SPLIZ
SPLIZ
  10-70-80-
25.
26.
27.
                        60 F = Y(II)
DFDX = 0.
RETURN
   SPLIZ
SPLIZ
SPLIZ
                       10 Y1 = Y(11)

X1 = X(11)

DFDX=(Y(1F) - Y1)/(X(1F) - X1)

F = Y1 + (T - X1)*DFDX

RETURN
   SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
28.
29
30.
31.
                       32.
   SPLIZ
SPLIZ
SPLIZ
SPLIZ
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SPLIZ
SPLIZ
SPLIZ
 33
35.
35.
37.
38.
39,
                       SPLIZ
 41.
42.
43.
44.
45.
46.
47.
   100
   SPLIZ
  SPLIZ
SPLIZ
SPLIZ
  SPLIZ
SPLIZ
SPLIZ
                     100 IL = LOCL(IT)
IF(T - X(IL)) 110,150,120
49
50
   SPLIZ
SPLIZ
   110-120-150
                    110 IL = IL - 1
IF(T - X(IL)) 110,140,140
51.
52.
   SPLIZ
SPLIZ
   140-ղ
  116-
                     120 IS = IL + 1

DO 130 I = IS, IF

IF(T - X(I ) .LT. 0.) 60 TO 140

130 IL = I
   SPLIZ
SPLIZ
SPLIZ
SPLIZ
53
54.
55.
56.
   146-
 57.
                     140 LOCL(IT) = IL
  $PL1Z
                    140 LOCK(IT) = IL

150 ILP1 = IL + 1

DX1 = T + X(IL)

DX2 = X(ILP1) - T

Y1 = Y(IL)

Y2 = Y(ILP1)

Z1 = Z(IL)

Z2 = Z(ILP1)

DEL = DX1 + DX2

TEMP1= Z2*DX1 + Z1*DX2

TEMP2 = SIXTH*DEL

F = ((Y2*DX1 + Y1*DX2) + SIXTH*(Z2*DX1**3 + Z1*DX2**3))/DEL

1 - TEMP2*TEMP1
   SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
58.
59.
60.
61.
63.
64.
65.
66.
   SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
SPLIZ
```

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# SUBRØUT I NE TABIN

### SUBROUTING TABIN SPECIFICATIONS

#### 1. PESCRIPTION

#### 'urpose:

Inputs a new case of data or inputs data for a different part case of the current case.

#### Comments:

Thus subroutine is to be a library subroutine.

for other information on this subroutine see also the General Programming "mual (AGI) published by MDAC for professional programmers and also bystem Pulletin, Peries 1108-10, dated 28 Oct. 1968.

#### lise:

Calling sequence is CALL TABLE (A, I, D, J, T, k, I, IFC, NUCASE, IEØD) where

- is a one-dimensional array allotted for the storage of alphanumeric information. Blanks will be placed in this array refore the data are input.
- is an integer constant or variable whose value  $(\geq 1)$  is the size of the array A.
- is a one-dimensional array allotted for the storage of Table C data. Peros will be placed in this array before the lata are input.
- is an integer constant or variable whose value  $(\underline{z}, 1)$  is the side of the array 0.
- " is a one-dimensional array illotted for the storage of the table of tables and the table data. Geros will be placed in this array before the data are input.
- is an integer constant or variable whose value (\_ 1) is the size of the array T.
- is a one-dimensional array which contains four locations. The basic deck number will be stored in P(1), the reference run number in M(2), the case number in M(3), and the part case number in P(4). Initially, this array must contain zeros. Once "ABIL has been called, this array must not be changed or zeroed out.
- IPC is an integer constant or variable whose value in the part case number requested.

NUCASE is an integer constant or variable whose value is zero if the current case is to be used, one if a new case is requested.

is an integer variable whose value will be set to plus one if there is no more data, and minus one if the part case requested was not input; otherwise, it is set to zero.

#### input:

TABIN reads tape NTAPE, which is set to equal FORTPAN logical tape 1.

The format of NTAPF is as follows:

Record n. Basic deck number n=1,3,5,...,k Reference run number Case number

Fart case number

Number of words of alphanumeric information

Number of words in Table 0

Humber of words in tables other than Table 0

(including table of tables)

Record n+1, Alphanumeric information

n=1,3,5,...,k Table 0 data

Table data other than Table 0 (including table of tacles)

Record k+2 Basic deck number = 9999

Six additional words, corresponding to the format of record n.

End of file.

#### Error Notes:

"BD = XXX, LR = X4, CAGH = XXX, PC = X4 ALPHANUTERIC ARRAY SIZE TOO SHALL = XX, X4, ILCESSARY SIZE = XXXXX EXECUTION TERMINATED BY TABLE."

"BD = XXX, NR = XX, CASL = XXX, PC = XX ARRAY FOR TABLE O TOO SMALL = XXXXX, REGESSARY SINE = XXXXX EXECUTION TERMINATED BY TABLE."

"BD = XXX, RR = XX, CASE = XXX, PC = XX ARRAY FOR TABLES TOO SMALL = XXXXXI, RECESSARY SIZE = XXXXX EXECUTIO, TERMINATED BY TABLE."

#### Definition of Symbols:

A is a one-dimensional array alloted for the storage of alphanumeric information.

BLAM is a word containing BCD blanks.

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Is a one-dimensional array allotted for the storage of Table 0 data.

DATA is temporary storage.

is an integer constant or variable whose value is the size of array A.

IBD is the previous basic deck number.

IBD1 is the basic deck number from tape.

113 is the previous case number.

1031 is the case number from tape.

is an integer variable whose value vill be set to +1 if there is no more data, and -1 if the part case requested was not input: otherwise it is set to 0.

IPC is the part case number requested.

IPCl is the part case number from tape.

1RR is the previous reference run number.

IRM is the reference run number from tape.

d is an integer variable whose value is the size of array D.

K is an integer variable whose value is the size of array ".

is used as in index.

is a one-dimensional array which contains four locations. The basic dock number is in M(1), the reference run number is in M(2), the case number is in M(3), and the part case number is in M(4).

WALPHA is the number of words of alphanumeric information.

is the number of words in tables other than Table 0 (including table of tables).

NTABO is the number of words in Table O.

MMAP: is the tape from which data are read.

ARCAGE is 0 if the current case is to be used, I if a new case is requested.

" is a one-dimensional array allotted for the storage of the table of tables and the table data.

GLOSSARY FOR SUBROUTING TABIN 1/27/91 PORTRAN CODE DESCRIPTION COMMON STORAGE SUBROUTINE USAGE SUBR CODE LOC SYMBOL SYMBOL BLOCK SYMBOL ONE DIMENSIONAL ARRAY ALLOTTED FOR THE STORAGE OF ALPHANUMERIC INFORMATION, (DIMENSIONLESS) (A) PIN MISATY A O RIGAT 0 BLANK **BLANK** C WORKING VARIABLE. (DIMENSIONLESS) /TABIN /(\* TABIN C BLANK BLANK **(C)** Ð Ô A VARIABLE LENGTH ARRAY ALLOCATED FOR THE STORAGE OF TABLE 0 (I.E. THE /TABIN /te TAREN ٥ Ð A ARRAY) DATA. (1) 1 Ħ THE SIZE OF THE A ARRAY. 1 /TABIN /(\* TABIN R 1 (IBD) IBD THE CURRENT BASIC DECK NUMBER IRD /TABIH /(c TABIN W 190 (IBDI) IBDI ī THE PREVIOUS BASIC DECK NUMBER /TABIN /(\* TABIN ŧ 1001 IBD1 (ICD TCS ¥ THE CURRENT CASE NUMBER 105 /TABIN /(0 TARIN ics (ICSI) 1081 1 THE PREVIOUS CASE NUMBER 1051 TABIN / (+ TARIM ٠ 1681 (ID) 10 CASE IDENTIFICATION AND TABIN ARRAY(T) ŦD TABIN /(# w 10 DATA SIZE INFORMATION (I E. BASIC DECK, REFERENCE RUN, CASE, PART CASE, NALPHA, NTAB, AND NTABO) (IEDD) THE DATA STATUS PLAG.

1 IF THERE IS NO HORE DATA
1 IF THE REQUESTED FART CASE
MAS NOT INPUT TROD 0 TROD /TABIN /(\* TABIH O IEOD OTHERWISE (IPD IPC 1 THE PART CASE NUMBER OF THE DATA TPC /TABIN /(\* TABIN I IPC REQUESTED. (IPCT) IPCT ARRAY(22) IT CONTAINS THE PART TABLE W TECT /TABIN /(+ IPCT CASE NUMBERS IN THE SEQUENCE IN WHICH THEY ARE PROCESSED FOR EACH (IPCI) TPC1 1 THE PREVIOUS PART CASE NUMBER IPC1 /TABIH /(\* TABIK I IPCL (IPPNTR) A POINTER IN THE JPCT ARRAY USED TO PROCESS THE PROPER PART EACH POR EACH GASE. IPPHTR M TARTH IPPHTE IPPHTR /TABIN /(\* . (IRR) TRR THE CURRENT REFERENCE RUN NUMBER IRR /TABIN /(\* TABIK (IRRI) 1221 1 THE PREVIOUS REFERENCE RUN NUMBER IRRI TABIN /(+ TABIN 1 IRRI ( THE SIZE OF THE D ARRAY. 1 /TABIN /(# TABIN 1 **(X)** THE SIZE OF THE T ARRAY. 1 /TABIN /(# TABIN 1 K W NO DESCRIPTION AVAILABLE TABIN /TABIN /4\* (LASTAB) LASTAB LARGEST TABLE NUMBER INPUT FOR A 0 LASTAB /LASTAB/:

71111 5

TABIN O LASTAS

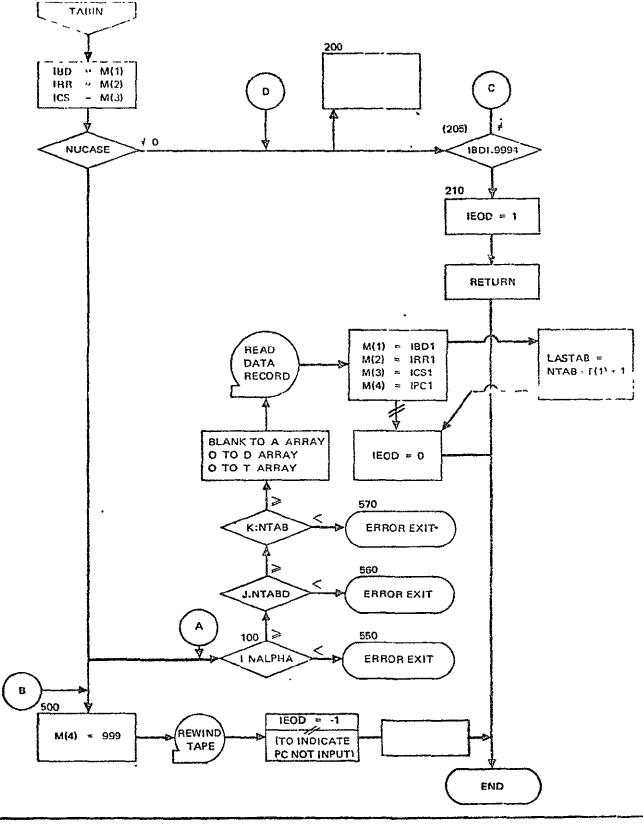
GIVPN CASE. (DIMENSIONLESS)

| FORTRAN        | HTAR     | CODS | DESCRIPTION                                                                                      | COMMON | STO     | RAGE          | SUPROUTING USAGE |   |                |  |
|----------------|----------|------|--------------------------------------------------------------------------------------------------|--------|---------|---------------|------------------|---|----------------|--|
| TYMBOL         | SYNBOL   |      |                                                                                                  | SYMBOL | BLOCK   | LCC           |                  |   | B YAR          |  |
| LNTBTB         | (LNTBTB) | 1    | THE LPNGTH OF THE TABLE OF TABLES SEE THE DEFINITION OF TABLE FOR MORE DETAILED INFORMATION.     | LNTSTS | /TABIN  | /(* 1         | TABIN            | ì | LNTSTS         |  |
| н              | 90       | Ħ    | ARRAY(4). THE CASE IDENTIFICATION DATA. (BASIC DECK, REFERENCE RUN, CASE, AND PART CASE NUMBERS) | Ħ      | HI BAT\ | /(* 1         | TABIN            | Ħ | ĸ              |  |
| MAXPGT         | MAXPCT   | c    | THE MAXIMUM NUMBER OF PART CASES<br>THAT MAY BE INPUT PER CASE                                   | HAXPCT | HIBAT\  | /( <b>+</b> ) | TABIN            | С | HAXPCT         |  |
| <b>Н</b> ЅИТСН | MSWTCH   | ¥    | WORKING PLAG USED TO TRANSPER TO THE CORRECT ADDRESS.                                            | HSWTCH | /TABIN  | /(+ )         | TABIN            | w | HSWTCH         |  |
| NALPHA         | (NALPHA) | 1    | THE NUMBER OF WORDS OF ALPHANUMERIC INFORMATION.                                                 | NALPHA | /TABIN  | /(* )         | TABIN            | ī | NALPHA         |  |
| MTAB           | (NTAB)   | 1    | THE NUMBER OF WORDS IN ALL TABLES OTHER THAN TABLE 0 (I.E. THE A ARRAY).                         | NTAB   | /TABIN  | /(\$)         | TABIN            | I | RATA           |  |
| DEATH          | COMPAND  | t    | THE NUMBER OF WORDS IN TABLE 0.                                                                  | PEATH  | /TABIN  | /(* )         | TABIN            | t | NTABO          |  |
| NTAPB          | OTAPE    | C    | THE FORTRAN LOGICAL FILE ON WHICH THE INPUT DATA IS WRITTEN.                                     | NTAPE  | /TABIN  | /(* )         | TABIN            | c | NTAPE          |  |
| NO ASE         | (NUCASE) | 1    | THE NEW CASE PLAG.  * 0 IF THE PRESENT CASE IS REQUESTED  * 1 IF A NEW CASE IS REQUESTED         | NUCASE | /TASIN  | /(* )         | TABIN            | 1 | HUCASE         |  |
| •              | ന        | М    | A VARIABLE LENGTH ARRAY ALLOCATED FOR THE STORAGE OF TABLE DATA.                                 | Ŧ      | /TABIN  | /(* )         | TABIN            | Ħ | Ť              |  |
| тавін          |          | В    | CASE OR PART CASE DATA INPUT<br>ROUTING.                                                         | TABIN  | /TABIN  | /(\$ )        | PASS1<br>TASIN   |   |                |  |
| ra <b>teln</b> | CLEIBFW  | 0    | THE PLOATING POINT VALUE (REAL) OF LINETE.                                                       | TBTBLN | /TABIN  | /(+ )         | TABIN            | ٥ | TOTOLM         |  |
| овгини         | (UNUSED) | 0    | STORAGE ALLOCATED TO READ IN UNUSED DATA (E.G. POR BYPASSING A PART CASS OF DATA)                | Gasana | /TABIN  | /(* )         | TABIN            | 0 | <b>4850</b> 40 |  |

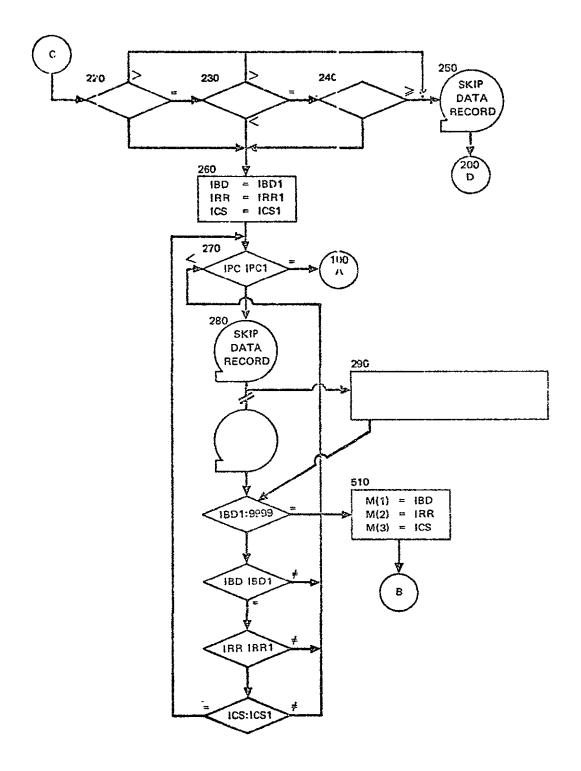
THAIR-6

# 2. FLOW DIAGRAM AND EQUATIONS IN ORDER OF SOLUTION

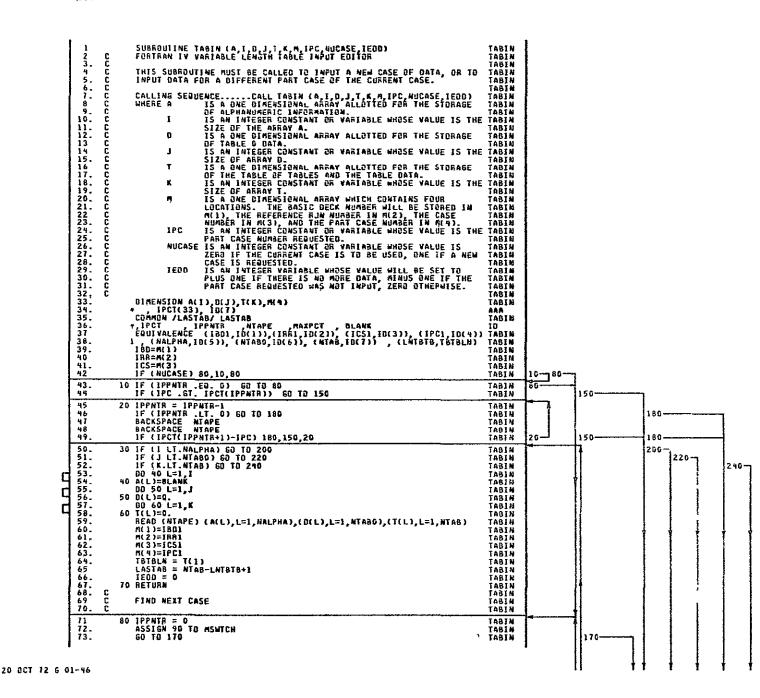
#### 2.1 FLOW DIAGRAM

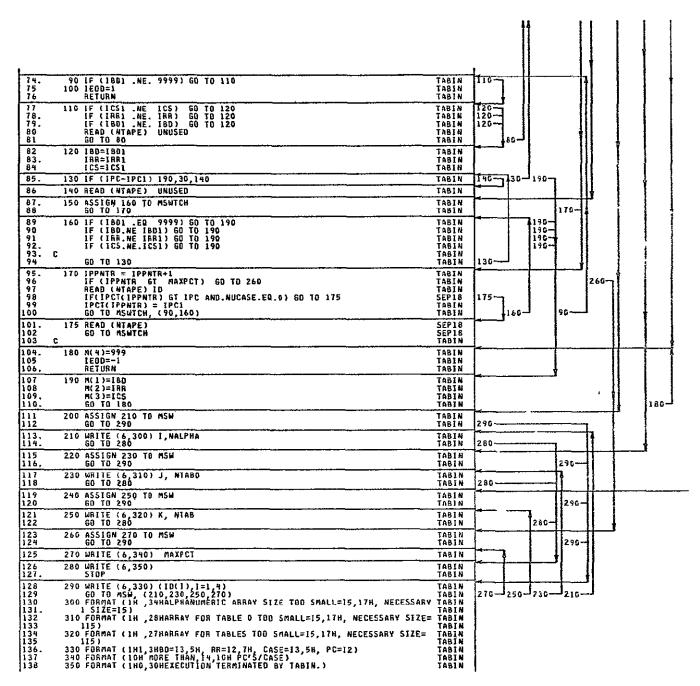


TABIN- X

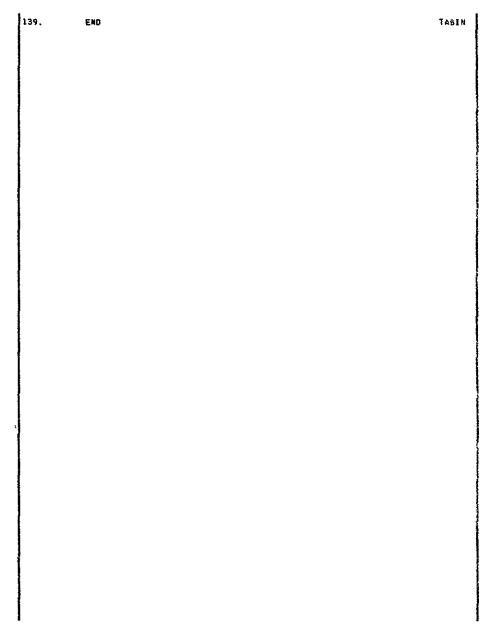


TABIN





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# SUBRØUT I NE WTDRP

### Subroutine WTDRP

### Purpose

Subroutine WTDRP calculates the weight dropped at booster staging in the rubber-stage optimization problem. It also calculates the sensitivities of the weight drop with respect to the booster burn-out weight.

### Description

The equations for this routine are described in Section 13 of Volume I.

| ORTRAN<br>Symbol | MATH<br>SYMBOL | CODE | DESCRIPTION                                                          | STORA:     | GE<br>LOC | SUBROU<br>SUBR                                                      |                            | E USAGE                                      |
|------------------|----------------|------|----------------------------------------------------------------------|------------|-----------|---------------------------------------------------------------------|----------------------------|----------------------------------------------|
| 3111006          | STROPE         |      |                                                                      | DEGGN      |           |                                                                     |                            |                                              |
| BK1              |                | ı    | Value of constant weight in booster stage weight equation            | /SIZING/(  | 279)      | SIZI<br>SIZZ<br>WTDRP                                               | I<br>I                     | BK1<br>BK1<br>BK1                            |
| BK2              |                | 1    | Value of linear term coefficient in booster stage meight equation    | /51Z1NG/(  | 280)      | SIZ1<br>SIZ2<br>WTDRP                                               | I<br>I<br>I                | BK2<br>BK2<br>BK2                            |
| BK3              |                | I    | Value of 1/3-power term coefficient in booster stage weight equation | /SIZING/(  | 281)      | SIZI<br>SIZZ<br>HTDRP                                               | I<br>I<br>I                | BK3<br>BK3<br>BK3                            |
| BK4              |                | 1    | Value of 2/3-power term coefficient in booster stage meight equation | /51Z1NG/(  | 282)      | SIZI<br>SIZZ<br>WTDRP                                               | I<br>I                     | 8K4<br>BK4<br>BK4                            |
| DWEB             |                | Ħ    | Sensitivity of booster stage weight to propellant weight (lb/lt)     | /SIZING/(  | 274)      | PAYLOD<br>SIZOUT<br>SIZI<br>SIZZ<br>STAU<br>WTORP                   |                            | OWEB<br>OWEB<br>OWEB<br>OWEB<br>OWEB<br>OWEB |
| DWEO             |                | Ħ    | Sensitivity of orbiter stage weight to propellant weight (lb/lb)     | /SIZING/(  | 275)      | PAYLOD<br>SIZOUT<br>SIZI<br>SIZZ<br>SIZZ<br>WTDRP                   | II                         | DWEO<br>DWEO<br>DWEO<br>DWEO<br>DWEO<br>BWEO |
| ITMBW            |                | 1    | Booster empty meght curve no.                                        | /\$1ZING/( | 317)      | SIZE<br>SIZI<br>SIZ2<br>WTDRP                                       | 0<br>1<br>1<br>1           | ITMBW<br>ITMBW<br>ITMBW<br>ITMBW             |
| ITHOW            | •              | I    | Orbiter empty waight curve no.                                       | /SIZING/(  | 316)      | SIZE<br>SIZ1<br>SIZ2<br>SIZ4<br>WTDRP                               | 0<br>I<br>I<br>I           | ITHOW<br>ITHOW<br>ITHOW<br>ITHOW<br>ITHOW    |
| OK1              |                | ī    | Same as bil except for orbiter .                                     | /SIZING/(  | 286)      | S1Z1<br>S1Z2<br>S1Z4<br>WTDRP                                       | 1<br>1<br>1<br>1           | 0K1<br>0K1<br>0K1<br>0K1                     |
| 0K2              |                | 1    | Same as bk2 except for orbiter                                       | /SIZING/(  | 287)      |                                                                     | I<br>I<br>I                | 0K2<br>0K2<br>0K2<br>0K2                     |
| BK3              |                | I    | Same as bk3 except for orbiter                                       | /SIZING/(  | 288)      |                                                                     | I<br>I<br>I                | 0K3<br>0K3<br>0K3<br>0K3                     |
| OK4              |                | I    | Same as bk4 except for orbiter                                       | /51ZING/(  | 289)      |                                                                     | I<br>I<br>I                | 084<br>084<br>084<br>084                     |
| WEB              |                | M    | Booster stage weight (ib)                                            | /SIZING/(  | 304)      | PAYLOD<br>SIZOUT<br>SIZI<br>SIZ2<br>SIZ4<br>TAMPAR<br>WIDAP         | I<br>H<br>H<br>I<br>I      | WEB<br>WEB<br>WEB<br>WEB                     |
| WED              |                | n    | Orbiter stage weight ( b )                                           | /SIZING/(  | 303)      | PAYLOD<br>SIZOUT<br>SIZI<br>SIZZ<br>SIZZ<br>SIZZ<br>TAMPAR<br>WTDRP | I<br>M<br>M<br>I<br>M<br>I | #E0<br>#E0<br>#E0<br>#E0<br>#E0<br>#E0       |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE     | DESCRIPTION               | <u>STORAG</u><br>Block | E<br>LOC | <u>S U8FOU</u><br>S U8F                           | TINE USA<br>CODE VA                                |
|-------------------|----------------|----------|---------------------------|------------------------|----------|---------------------------------------------------|----------------------------------------------------|
| WPB               |                | M Boost  | er propellant weight (16) | /SIZING/(              | 277)     | SIZOUT<br>SIZ1<br>SIZ2<br>SIZ4<br>TAMPAR<br>WTORP | I WP8<br>M WP8<br>M WP8<br>I WP8<br>I WP8          |
| WP8               |                | M Orbito | r propellant meight ( b)  | /SIZING/(              | 312)     | SIZOUT<br>SIZI<br>SIZ2<br>SIZ3<br>SIZ4<br>TAMPAR  | I WPG<br>M WPG<br>M WPG<br>I WPG<br>M WPG<br>M WPG |

```
SUBROUTINE WTORP(WPP, WIO, WIO, WIO, I)

THIS ROUTINE CALCULATES WEIGHT DROPPED FOR OPTIMAL STAGING WTORP
AND PARTIAL OF WT. DROPPED WITH RESPECT TO BODSTER CUT-OFF W WTORP
REAL MUB, MUD, ISPB, ISPO, IDVEL, MNB, NO
COMMON /SIZING
SIZING
FHASE II SIZING PARRABERERS
TZ, VV(3), OP(14), EROR, PZ(5), VQ, SW(20), SIZING
SIZING
SV(28), SQ(37,5), SE(11), TLAT, TLNG,
PHASE I SIZING PARAMERERS
WBD, HLOD, DWEB, DWED, TOLWT, WPB, TWRATZ, SIZING
**SKI, BKZ, BK3, BK4, ISIZE, TRAFLG, TWRATO, SIZING
**OK1, OKZ, OK3, OK4, PRFLG, IPASS, IPSAMS, SIZING
**OK1, OKZ, OK3, OK4, PRFLG, IPASS, IPSAMS, SIZING
**OK1, TVACD, ND, WFO, IDVEL, ISPO, ISPB, SIZING
**XPL, TVACD, ND, MED, WEB, MD, WLO, SIZING
**XPL, TVACD, ND, MED, WEB, MD, WLO, SIZING
**XPL, TVACD, ND, MED, MED, WEB, MD, WLO, SIZING
**SVOPSQ, SVOCON, INUNT, IOPSTG, ISZO(19)
IF( I.LT.O) GO TO 3

WTORP

**ITIMAL STAGE WI AND SENSITIVITY
**DOSTER STAGE WI AND SENSITIVITY
10FA58
  BODSTER STAGE MT AND SENSITIVITY
                                 1 IF(BK1.ST.C.O) GO TO 2
CALL SPLIZ( 1TNBW, MPB, WEB, DWEB)
GO TO 5
                                 2 WEB = BK1 + BK2+ WPB+ BK3+ WPB++0.3333+ BK4+ WPB++0.6667

DMEB= BK2 + BK3+ 0.3333+ MPB++(-0.6667)+ BK4+ 0.6667+ WPB++

+ (-0.3333)
26.
27.
28.
   JULY28
JULY28
JULY28
29.
30
31.
32 t
33. C
34. C
                                 5 WID = WEB
WIDW = DWEB
RETURN
   10FA58
10FA58
10FA58
  DRBITER STAGE WY AND SENSITIVITY
   JULY28
  JULY28
 35.
                                 3 WPO = WPP
   JULY28
   TF(0K1.GT.0.0) 60 TO 4
CALL SPLIZ(11NOW, MPO, MEO, DMEO)
60 TO 6
 36
37.
38.
   JULY28
JULY28
JULY28
                                 4 WEO = OK1+ OK2-WPO+ OK3+ WPO++ 0.3333+ OK4+ WPO++ 0.6667

OWEO= OK2+ 0.3333+ OK3+ WPO++(-0.6667)+ 0.6667+ OK4+ WPO++

+ (-0.3333)
39.
40.
41.
   JHLY28
   JULY28
                                 6 WID = WED
WIDW = DWED
RETURN
END
 42.
43.
44.
  JULY28
  JULY28
JULY28
JULY28
```

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Input Editor (INEDIT) 3

### CONTENTS

Program TABE

Subroutine INEDIT (with input data, part-case structure)

Subroutine Packer

Subroutine S (MDAC 6500 only)

# TABE

### TABE

### Purpose

TABE is a dummy executive program that heads up the input edit overlay (overlay containing INEDIT).

TABE

PROGRAM TABE CALL INEDIT RETURN END

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1311/

# SUBRØUT I NE I NED I T

#### Subroutine INEDIT

### Purpose

INEDIT reads input data card images using NAMELIST and stores cases and part cases on input file 1 for access by the various modules of PADS.

#### Description

INEDIT first reads each data card separately, prints its image, and then copies it on to File 4. File 4 will then contain all data card images, and serve as the input file for subsequent NAMELIST reads.

The first NAMELIST read (\$XX) either reads in control flags or fills common block /AA/ with trajectory and Phase I sizing data.

At the end of common block /AA/ are three arrays used for storing the data from the other NAMELIST reads associated with SSSP sizing problems.

These NAMELIST sets are \$DATA 3 and \$DATA 2.

After reading data into common block/AA, INEDIT scans for key quantities that have actually been input (words that are non-negative zero) and sets up part cases to be stored on file 1.

The part case and table structure resulting from this processing are charted below.

| Part<br>Case<br>No. | Description of Data                                            | Common block/ or (routine) where date used | Extent<br>In<br>/AA/ array |
|---------------------|----------------------------------------------------------------|--------------------------------------------|----------------------------|
| 1                   | fixed length table Tables 1-30 variable length univariant data | /GLOBAL/<br>/TBLE/<br>(SPLICO)             | GR → DUM 5<br>CLA (70, 30) |
| 2                   | Table 1 Initial conditions Table 2 Target condition            | (ĠEINP)<br>(BNDRYC)                        | T1-TIME1 PAYOFF-CT20       |

| Part<br>Case<br>No. | Description of Data                                                 | Common block/ or (routine) where date used | Extent<br>In<br>AA array       |  |
|---------------------|---------------------------------------------------------------------|--------------------------------------------|--------------------------------|--|
| 4                   | Table 1, steepest descent starting solution phase sequencing        | (SDIN-P)                                   | PH1→PH20                       |  |
| 5                   | Table O, steepest descent convergence data                          | /STS/<br>(SDINP)                           | DPAY→DLPI                      |  |
|                     | Table 1-20 steepest descent<br>starting solution control<br>history |                                            | TCØNA                          |  |
| 6                   | Table O Bivariate table arguments.                                  | $(BLIC\phi)$                               | TALFAl→<br>TMACH1              |  |
|                     | Tables 1-31 Bivariate table.                                        |                                            | TCLCD1                         |  |
| 7                   | Table O, Bivariate table arguments. Table 1-31 Bivariate table.     | (BLICØ)                                    | TALFA2→<br>TMACH2<br>TCLCD2    |  |
| 8                   | Table O, Bivariate table arguments.                                 | (BLicø)                                    | TALFA3 <del>-→</del><br>TMACH3 |  |
|                     | Tables 1-31 Bivariate table.                                        |                                            | TCLCD3                         |  |
| 9                   | Table O, Bivariate table arguments                                  | $(BLIC\phi)$                               | TVELT→<br>TALT                 |  |
|                     | Tables 1-31 Bivariate table.                                        |                                            | THSF                           |  |
| 10                  | Table O sizing data                                                 | /SIZING/                                   | WB <b>Ø→</b> ISZD              |  |
| 11→30               | Table O ARC data                                                    | /ARCDAT/                                   | SREF→<br>DUM20                 |  |
| 31                  | Table O Booster data                                                |                                            | AB ,                           |  |
| 32                  | Table O Orbiter data                                                |                                            | AC                             |  |
| 33                  | Synthesis data                                                      |                                            | AD                             |  |

```
SUBROUTINE INEDIT
COMMON/IT/INTBD, INTRR. INTCS, IPC, NALPHA, NTABO, NTAB, NT, NTOT, JTOT(31) INEDIT
EQUIVALENCE (IDENT, INTOT)
INEDIT
OMMON/FLAGS/ KMOD, KMAKBO, BD, RR, CS, MODCS, MAKEBO, SIZING INEDIT
INEDIT
INEDIT
1.
2.
3.
4.
5.
67.
89.
  INEOIT
INEOIT
INEOIT
                                       C
   INTEGER BD, RR, CS, SIZING, EXTBD, EXTRR, EXTCS, OUT
  REAL INNER, ITAMAX, NARC,
  1 IANER, ITAMAX, NARC,
2 MUI;
5 MITER,
9 ISIZE, IPASS, IPSMAX, NO, IDVEL, ISPO, ISPB, NNB, MUB, JTYP, ITMBW, ITMOW,
9 ISIZE, IPASS, IPSMAX, NO, IDVEL, ISPO, ISPB, NNB, MUB, JTYP, ITMBW, ITMOW,
1 IATM, IMODE, JAER, JPRO, LFTMAX
FOR DATA3
REAL ISP, ITPS, K, KIN, LF, MR, NCREW, NENGS, NLISTO, NPASS, NWL
FOR DATA4
11
12.
13
14
  INEDIT
INEDIT
   C
  INEDIT
INEDIT
                                      C
  INEDIT
INEDIT
INEDIT
  ISLB, ISLO, IVACB, IVACO, NXFOB, IDVELO
  INFRIT
   INEDIT
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  PRI
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   DIMENSION SNB (20), SNA(20)

COMMON/AA/

IGR.R. DMGZ.RHORF.YMURF.PRCO.DUMI.EPSLON.INNER.ITRMAX.BUM2(1), MARC.

IDUM3(49), PSIRF.PFLGI,PFLG2,FFLG3,PFLG4,DUM4(20),TPSDL,DUM5(9),

ITCLA(70,30).

211 (2), 12 (2), 13 (2), 14 (2), 75 (2), 16 (2), 17 (2), 18 (2), 19 (2),

211 (2), 111(2), 112(2), 113(2), 114(2), 115(2), 116(2), 117(2), 118(2),

211 (2), 170(2), 11 (2), 12 (2), 13 (2), 14 (2), 15 (2), 16 (2), 17 (2),

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NNB,
HUB,
BSTG,
  INEDIT
  9DUM25, DUM26, BST6, ORBI, ITMBM, ITMON, ISZO(13)
COMMON/AA/
ASREF (20), AEXIT (20), XISP (20), THULL (20), DUM2 (20), PFRQ (20), ALITM (20), TMODE (20), JAER (20), THORA (20), THOLA (20), ALFTMAX(20), THODO (20), THEK (20), TACRO (20), THOMA (20), THOLA (20), ATNGLO (20), THOSE (20), TACRO (20), THOMA (20), THORA (20), THOMA (20), THOLA (20), ATNGHO(20), XIGH (20), THOLA (20), THOMA (20), THOMA (20), THOMA (20), THOMA (20), THOMA (20), THOMA (20), ATNGHO (20), LATNGHO 
  INEDIT
  INCRIT
   INEDIT
INEDIT
INEDIT
   INCOLL
   INEDIT
INEDIT
INEDIT
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```
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POW
INEDIT
  *,($000,15Z0(4)),($0$P,15Z0(5))
REAL IHUNT
           77
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79
80.
   88888888991234
998888888991234
9988888888991234
   THEO. TOLLY LUPS, BN. 1, 82, 843, 844, 1512, THAFLE, TURATO, DK. 1, 082, 083, 084, 1801T SPRRIGE, 1PASS, 1PSRAX, EXITA T VACO, NO. WFO, 10VEL 15PO, 15PB XPL, TVASTO, WIRD, NUMB, WED, WED, WED, WED, WED, WED, ORDER, ORDE
  C
     105
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     140.
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   INEDIT
INEDIT
  NAMELIST TO READ IN DATA
    146.
147.
148.
149
   INEDIT
INEDIT
INEDIT
  NAMELIST/DATA3/
1ANENGS ANTANK ASRATO ASMEEP C CBBODY
2CHBODY CLBODY CSBODY CSFAIR CSFUTK CSHORZ
3CSPLAN CSVERT CSWING CTHRST CTHST2 DEF
```

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```
HISP TIPS K
SHENGS NLISTO NPASS
6RHOFUZ RHOX RHOX2
7TYTAIL VBOOY WGROSS
  MR ACREM
A RHOFU
TOWERC TPRATO
   IMEDIT
   PCHAM
TOL
   151
   NWL
SBODY
NODATA
   INEDIT
   152.
   INEDIT
   153.
  154.
155. C
156 C
157. C
158. C
   INCOIT
   INEBIT
                       NAMELIST TO PRINT OUT INPUT DATA
   INEDIT
   INEDIT
   INEDIT
                    NAMELIST/DATA2/ALD, FBPAR, IDVELD, ISLB, ISLD, IVACB, IVACD, PERISP, OMXX, UH

1 DRXS, SFC, SLVDUT, COPIES, SVMIT, IFCTRD, TFCTRD, TOLMU, TOLTM, IMEDIT

2 TRATID, TWLD, TWLDI, WTDUT, FIRE, ABOUTM, VCRUSE

3 NXFOB, PRNTX, FSEC, CLVG, DRNG

4, SOLID, AS, BS, SISP, SIMERT, SAE, TSBD, FLYBCK

5 WFOREQ, WOREQ, GAMEQ

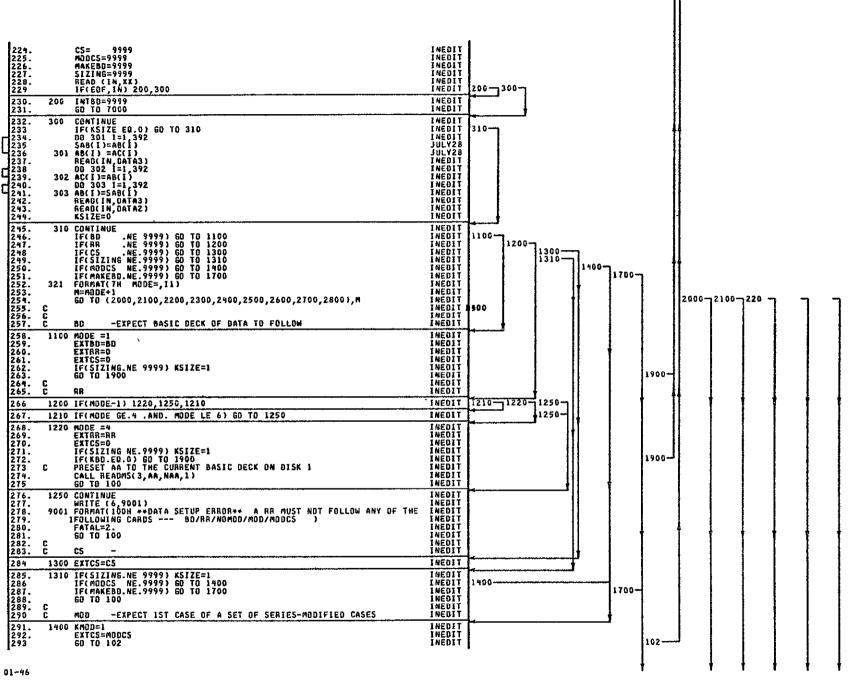
6, FBFUEL, CA, CB, WFLYX, RT, R1, R3, SFC1, SFC2, SFC3, ALO1, ALD2, ALD3, VFLY1, IMEDIT

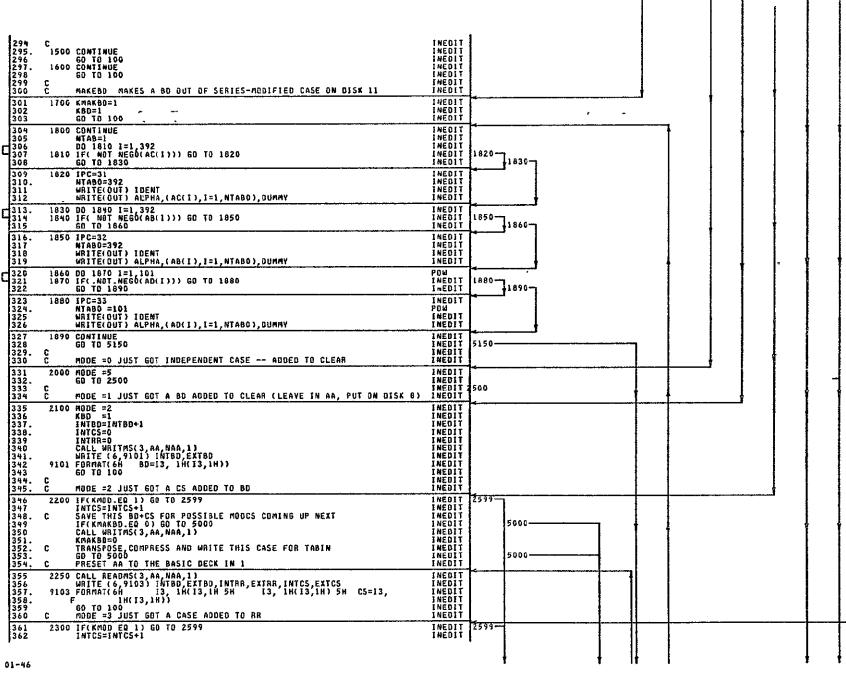
7 VFLY2, VFLY3, NODATA

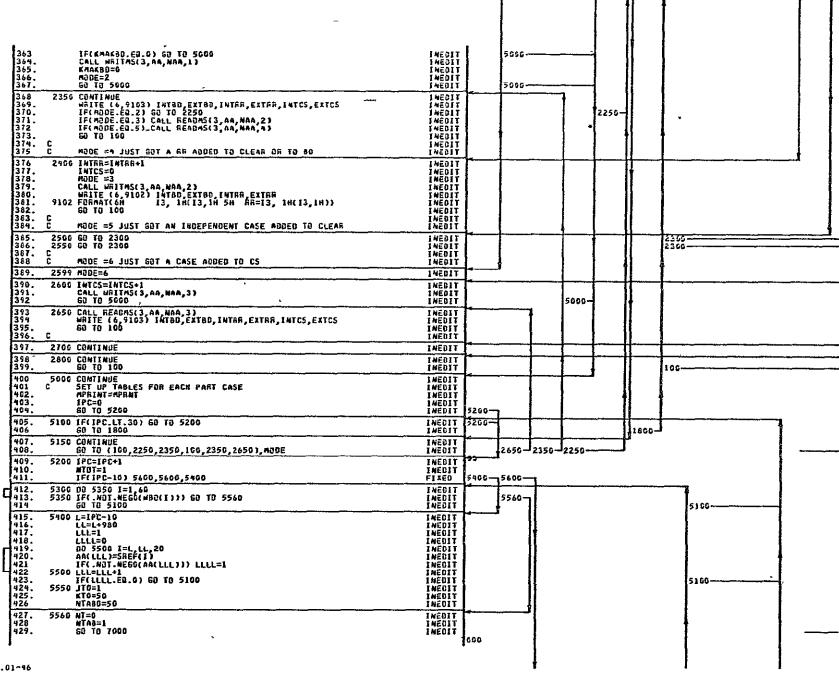
*, PNDX, BUPP, BLOW, STEP, RVAR, PAYX

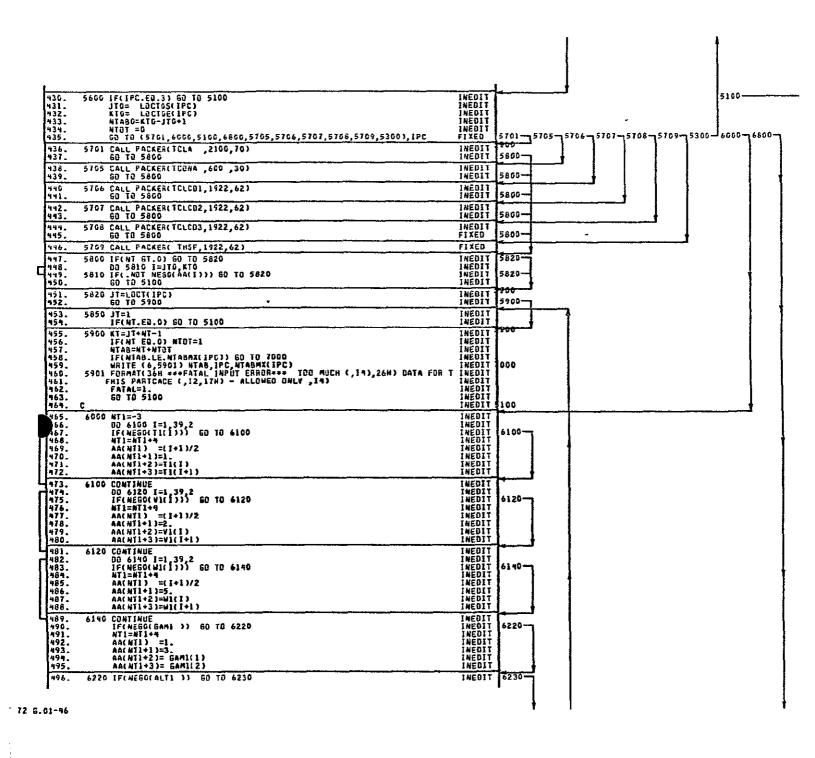
INEDIT

*ONDATA*
   INEDIT
   160
   161.
   162.
   164
   165.
   166.
167.
168
  POW
   169
            C
                      INEDIT
  171.
172
   FIXED
   FINI
  173.
174.
175
   FINE
  FIXED
FIXED
   FIXEO
   176.
177.
   FIXED
   1178
            C
   INEDIT
                       DATA FINITY/9988776655./
   179.
   INEDIT
                      DIMENSION ALFNU(13)
LOGICAL MESO
MEGO(X)=X.EQ.O. .AND. SIGM(1.,X).LT.O.
   HB
   180.
   INEBIT
   181.
182.
   INECIT
   183. C
                      MFRNT=1
ASSUMING 60 HDS IN PC=9
NAA =13075
   INEDIT
   184.
185
186.
187.
188.
189.
            C
   INEDIT
  FIXED
                       NAA =13096
  F141
                      DO 50 I=1, NAA
   INEDIT
                      AA(I)=-0.
CALL WRITMS(3, AA, NAA, 4)
   INCOIT
   INEDIT
  191.
                       CALL S(1)
                       IN=4
   ИG
   ÜĞ
  193
                       REWIND IN
                     DD 3 I=1,10000
READ(5,4) ALFNU
IF(EOF,5) 5,2
194.
195.
196
   ŬĞ
   UG
   ÜĞ
197.
198.
199
                  2 WRITE(IN 4) ALFNU
WRITE(6,6) ALFNU
3 CONTINUÉ
   ЦĞ
   IJĠ
   HS
  UG
   200.
                   5 REWIND IN
  UG
UG
INEDIT
                   4 FORMAT(13A6)
   202.
                   6 FORMAT(X,13A6)
  202.
203.
204.
205.
206.
207.
208.
210.
211.
212.
                      OUT=1
READ CONTROL CARD INFO
   INEDIT
   INEDIT
                      KMAKBB=0
                  11 CONTINUE
   INEDIT
   INEDIT
                       MODE= 0
   INEDIT
                       INTRD=0
   INEDIT
                      INTER=0
   INEBIT
                      INTES=0
                      EXTED=0
   INEDIT
                      EXTAR=0
   INEDIT
                      EXTCS=0
   INEDIT
  214.
215.
  INEDIT
                       KBD=0
                       KSIZE=0
  INFOIT
  216
217.
218.
  INEDIT
                       ALPHA=6H
                      HALPHA=1
   INFRIT
   INEBIT
                      FATAL=0.
   INEDIT
   219
              1900 CALL READMS(3, AA, NAA, 4)
   INEDIT
   220.
              100 KM0D=0
  221.
222.
223.
                      CONTINUE
  INEDIT
               102
  INEDIT
                       BD=9999
                       RR= 9999
  INEDIT
```





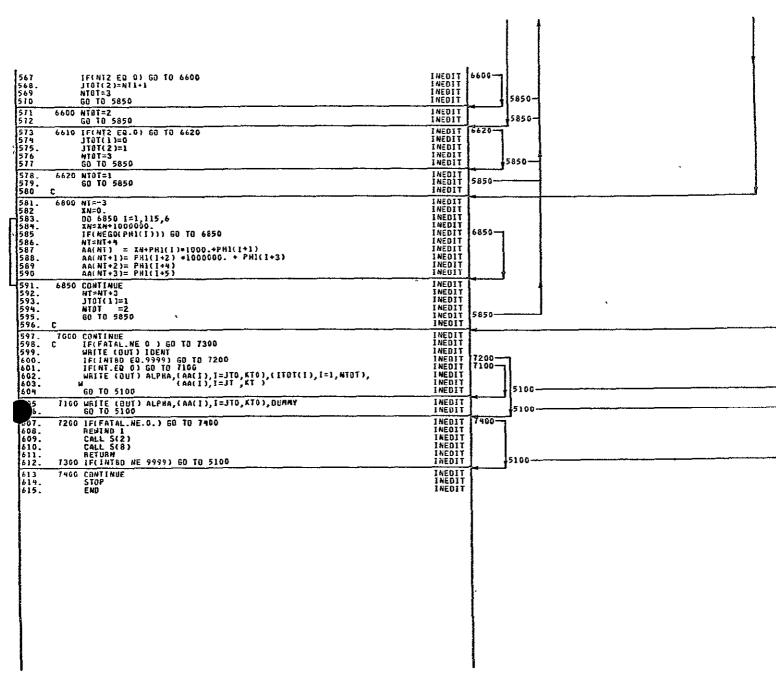




1/2

| 197 NT1=NT1+4                                                                          | INEDIT .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8. AA(NT1) =1.<br>9. AA(NT1+1)=4.<br>0. AA(NT1+2)= ALT1(1)                             | INEDIT<br>INEDIT<br>INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| D1. AA(NT1+3)= ALT1(2) D2 6230 IF(NEGG(PS11 )) 6D TO 6240 D3. NT1=MT1+4                | INEDIT 6240-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 04. AA(MT1) =1.<br>05. AA(MT1+1)=6<br>06. AA(MT1+2)= PSI1(1)                           | INEDIT<br>INEDIT<br>INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 7 AA(NT1+3)= P511(2)<br>8 6240 IF(NEGO(RHO1 )) GO TO 6250                              | INEDIT 6250-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 9 NI=NI1+4<br>0. AA(NI1)=1.<br>1. AA(NI1+1)=7.<br>2 AA(NI1+2)= RHD1(1)                 | INCOLT<br>INCOLT<br>INCOLT<br>INCOLT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3                                                                                      | INEDIT 6260                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 16. AA(NT1)=1.<br>17. AA(NT1+1)=8.<br>18. AA(NT1+2)= MU1(1)                            | INEDIT IN |
| 19 AA(NT1+3)= MUI(2) 20 6260 IF(NEGO(H1 )) GD TO 6270 21. NT1=NT1+9                    | INEDIT 6270-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 22 AA(NT1)=1.<br>23. AA(NT1+1)=10.<br>24 AA(NT1+2)= HI(1)<br>25. AA(NT1+3)= HI(2)      | INEDIT<br>INEDIT<br>INEDIT<br>INEDIT<br>INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 26. 6270 IF(NEEO(SQ) )) 60 TO 6280<br>27. NT1=NT1+9                                    | INEDIT 6280-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 28. AA(NT1)=1.<br>29. AA(NT1+1)=11.<br>30. AA(NT1+2)= \$Q1(1)<br>31 AA(NT1+3)= \$Q1(2) | INEDIT<br>INEDIT<br>INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 32. 6280 I=(NEGO(TIM1 )) 60 TO 6290<br>33. NTI=NTI+4                                   | INEDIT 6290                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 34. AA(NT1)=1.<br>35. AA(NT1)=9.<br>36. AA(NT1+2)= T[M](1)                             | INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 37. AA(NT1+3)= TIM1(2) 38 6290 CONTINUE 39. NT1=NT1+3                                  | INEDIT INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 540. NT2=NT1-3<br>541. IF(NEGG(PAYOFF)) 60 TO 6510                                     | INEDIT   6510-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 42.                                                                                    | INEDIT INEDIT INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 45 AA(NT2+2)= SIGN(2.,PAYOFF(2))<br>46 AA(NT2+3)= PAYOFF(3)                            | INEDIT<br>INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 47. 6510 DO 6550 I=1,22,3<br>48 IF(NEGOCON1(1)5) GO TO 6550<br>49. NT2=NT2+4           | INEDIT 6550                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 550. AA(NT2) = CN1(I)<br>551 AA(NT2+1)= CN1(I+1)                                       | INEOIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 52. AA(NT2+2)=0.<br>53. AA(NT2+3)= CN1(I+2)<br>54. 6550 CONTINUE                       | INEDIT INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 55. DO 6580 I=1,39,2<br>56. IF(NEGO(CTI(1))) GO TO 6580                                | INEDIT 6580-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 57 NT2=NT2+4<br>58 AA(NT2) =(1+1)/2<br>59 AA(NT2+1)=AB5(CT1(1))                        | INEDIT INEDIT INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| AA(M12+1)=AB5(C11(1))<br>561 AA(MT2+3)=CT1(1+1)                                        | INEDIT<br>INEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 62 6980 CONTINUE<br>63. NT2=NT2-NT1+3                                                  | I NEDIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 64. MT=MT34MT2<br>65 IF(MT1 EQ.O) GD TO 6610<br>66. JTDT(1)=1                          | INEDIT 6610-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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### Subroutine PACKER

### Purpose

Subroutine PACKER packs univariant and bivariate tables for inclusion on file 1.

### Description

PACKER is called by INEDIT to process the input data tables into a form that is stored on file 1.

```
600-
  500-
      500 NTOT=NOT
60 TO 1000
18.
19
  INEDIT
INEDIT
   1000-
20.
      600 STOTENOT)=0
  INEDIT
21.
22.
23.
24.
25.
      1000 CONTINUE
MT=NT-1
MTOT=NTOT+1
RETURN
END
  INEDIT
INEDIT
INEDIT
INEDIT
INEDIT
```

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## SUBRØUT I NE S

```
3
```

```
SUBROUTINE S(L)
COMMON/IT/J[(3)
CALL SECOND(T)
DT=T-TO
WRITE(6,1) L,T,DT
1 FORMAT(25H ***MARK TIME AT LOCATION,J2,3H T=,F6.3,6H
TO=T
RETURN
END
   INEOIT
INEOIT
INEOIT
INEOIT
INEOIT
INEOIT
INEOIT
INEOIT
INEOIT
  DT=F6 3)
```

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Input Scan (GEINP)

### CONTENTS

SubroutineGEINPSubroutineBLIC $\phi$ SubroutineBNDRYCSubroutineM $\phi$ MENTSubroutineSPIC $\phi$ 

# SUBRØUT I NE GE I NP

#### GEINP

### Purpose

GEINP reads various data sets from the input tape file, puts some in common blocks, and calls other routines that process data before storing.

#### Description

GEINP is an overlay program on CDC equipment whereas it is a subroutine on the UNIVAC system.

The data that GEINP uses is fetched by calling TABIN according to "Part Case" number. (TABIN reads the data from unit 1. For a description of how data gets on unit 1 see Subroutine INEDIT). The part cases that are read in this routine (in the same order as read) are:

| Part Case<br>Number | Description                                                                                                                            | Common<br>Blocks   |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| 1                   | GLOBAL, data and univariant tables (subroutine SPLICØ spline fits tables and stores them in common block/TABLE/).                      | /GLOBAL/<br>/TBLE/ |
| 11 - 30             | BLOCKS OF ARC DATA read in and processed by FXDAT and then stored on random file 9, records 1 through 20.                              | /ARCDAT/           |
| 6, 7, 8             | Bivariate aerodynamics tables read in and processed by subroutine BLIC $\phi$ and stored on random files 33, 34, and 35, respectively. | /BICUBE/           |
| 9                   | Bivariate Airbreather thrust table, read in and processed by subroutine BLIC $\phi$ and stored on random file 36.                      | /BICUBE/           |
| 10 .                | SIZING Data is read in and stored in /SIZING/                                                                                          | /SIZING/           |
| 2                   | Boundary condition data is read in and processed in BNDRYC.                                                                            |                    |
|                     | It is stored after processing on random file 9, record 21.                                                                             |                    |

| FORTRAN<br>Symbol | MATH<br>SYMBOL   | CODE | DESCRIPTION                              |                                        | STORAGE<br>BLUCK U | .oc | <u> </u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | CODE                                 | US AGE<br>VAR                                                                        |
|-------------------|------------------|------|------------------------------------------|----------------------------------------|--------------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------|
| ARCDA             | S <sub>ref</sub> | M    | Aerodynamic reference area               | (FT <sup>2</sup> )                     | /ARCDAT/(          | 1)  | BNIG<br>EQUAS<br>ENTG<br>FXDAT<br>FXDAT<br>GEINP<br>SDINP<br>SIZIN<br>SIZIN<br>THRUST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1<br>1<br>1<br>0<br>m<br>1<br>1<br>m | ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>SREF<br>SREF |
| BNARR             |                  | พ    | Packed array of boundary conditions      |                                        | /GEINP /(#         | }   | GEINP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ш                                    | BNARR                                                                                |
| DTNC              | Δτ               | M    | Integration interval                     | (SEC)                                  | /ARCDAT/(          | 5)  | BNTG<br>FNTG<br>GEINP<br>PROPIN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | I<br>I<br>M<br>I                     | DTNC<br>DTNC<br>DTNC<br>DTNC                                                         |
| DTPI              |                  | M    | Print frequency for trajectory           |                                        | /ARCDAT/(          | 6)  | FNTG<br>GEINP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | I<br>A                               | OTPI<br>OTPI                                                                         |
| ER                | E <sub>R</sub>   | 1.   | Earth radius                             | (FT)                                   | /GLOBAL/(          | 2)  | COORDS<br>CRASH<br>EQUAS<br>GEINP<br>PADS1<br>POBC<br>SOMG<br>TRTOSZ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | I<br>I<br>I<br>I<br>I                | ER<br>REM<br>ER<br>ER<br>ER<br>ER<br>ER                                              |
| 6                 | g r              | I    | Gravitational acceleration at surface of | f the earth.<br>(FT/SEC <sup>2</sup> ) | /GLOBAL/(          | 1)  | ACCEL<br>BLDA3<br>FEH3 NP<br>GEINP<br>GEINP<br>GUIT<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>PADS1 |                                      | GRRGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG                                               |
| GR                | 9 <sub>F</sub>   | ī    | Gravitational acceleration at surface o  | f the earth.<br>(FT/SEC <sup>2</sup> ) | /GLOBAL/(          | 1)  | ACCEL<br>BLUBAB<br>BEHBAB<br>GEINP<br>GEINP<br>DADGI<br>POBUS<br>SDINP<br>POBUS<br>SSIZZI<br>SSIZZA<br>SSIZZA<br>STAU                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                      | GR<br>GRR<br>GGRR<br>GGRR<br>GGRR<br>GGRR<br>GGRR<br>GGRR<br>G                       |

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| FORTRAN | MATH   | cone | DESCRIPTION                                                                                                                                                                        | STORAG     |     | <u> 5                                   </u>                                                                                                     | TINE             | USAGE                                                    |
|---------|--------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------------------------------------|
| ZAMROT  | SYMBÜL |      | 0230mm 170m                                                                                                                                                                        | คโปโห      | LOC | รบลห                                                                                                                                             | LOUE             | HAV                                                      |
| 10      |        | Ţ    | A four word array containing the basic deck, reference run, case and part case numbers in that order                                                                               | /GLOBAL/(  | 21) | BLICO<br>FRENCH<br>GEINP<br>PADS1<br>PRINT<br>SDINP<br>TOPM<br>VEHDF                                                                             | I                | 10<br>10<br>10<br>10<br>10<br>10                         |
| IFATAL  |        | 0    | Fatal error flag.                                                                                                                                                                  | /GĽOBAL/(  | 17) | BLICO<br>GEINP<br>PADS1<br>SDINP<br>SPLICO<br>STPIT<br>TOPM                                                                                      | I<br>M<br>M<br>O | IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL |
| I G     | gr     | 0    | Gravitational acceleration at surface of the earth.  (FT/SEC <sup>2</sup> )                                                                                                        | /GLOBAL/(  | 1)  | ACCEL<br>BL5<br>EQUA3<br>FH3<br>GEINP<br>GEINP<br>GEINP<br>HOBC<br>REU3<br>SDINP<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE |                  | G G G G G G G G G G G G G G G G G G G                    |
| ITAB    |        | ì    | A 20 word array containing the number of nonzero state initial conditions specified at the beginning of each subarc.                                                               | /GLOBAL/(  | 45) | GEINP<br>SDINP<br>SIZIN                                                                                                                          | I<br>I           | ITAB<br>ITAB<br>ITAB                                     |
| JAER    |        | 1    | Aerodynamic model option flag                                                                                                                                                      | /ARCDAT/(  | 9)  | BEROCO<br>EQUAS<br>GEINP<br>OUT<br>PROPB<br>PROPIN                                                                                               | I<br>I<br>I<br>I | JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER     |
| JAF     |        | u    | Saved aero option codes for each arc                                                                                                                                               | /GEINP /(+ | )   | GEINP                                                                                                                                            | ы                | JAF                                                      |
| JPRO    |        | I    | Propulsion model option flag                                                                                                                                                       | /ARCDAT/(  | 10) | EQUAS<br>GEINP<br>IMPUL<br>MODELA<br>PROPB<br>PROPIN                                                                                             | 1                | JPRO<br>JPRO<br>JPRO<br>JPRO<br>JPRO<br>JPRO             |
| KTAB    |        | 1    | A 20 word array containing the number of state target conditions specified at the end of each subarc.                                                                              | /GLOBAL/(  | 25) | GEINP<br>SDINP<br>SIZIN                                                                                                                          | I<br>I<br>I      | KTAB<br>KTAB<br>KTAB                                     |
| LUM     |        | I ,  | Program control flag.  LUM = 0: Steepest descent only;  LUM = 1 Steepest descent and adjoint  transformation stored on tape;  LUM = 2: Steepest descent and QL;  LUM = 3: QL only. | /GLOBAL/(  | 6)  | AST3<br>FNTG<br>GEINP<br>PADS1<br>SDINP<br>TOPM                                                                                                  | I<br>M<br>I      | COM<br>LUM<br>LUM<br>LUM<br>LUM<br>LUM                   |
| MAEA    |        | I    | Curve number                                                                                                                                                                       | /ARCDAT/(  | 18) | EQUAS<br>GEINP<br>PROPB<br>PROPIN                                                                                                                | I<br>I<br>I      | MAEA<br>MAEA<br>MAEA<br>MAEA                             |

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| ORTHAN    | HAIH                 | CODE     | DESCRIPTION                | ) N            | STORAGE     |     | SUBROUT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                       |
|-----------|----------------------|----------|----------------------------|----------------|-------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| ( Abhr()) | 24400F               |          | DE JOHIT TIE               | /   <b>   </b> | BIOLK (     | LOC | 508R C00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | E VAR                                                                 |
| VARC      | N <sub>3</sub>       | M Number | of subarcs in the problem. |                | /GŁOBAL/(   | 18) | FNTG I<br>GEINP M<br>PROPIN I<br>SDINP I<br>SIZIN I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | NARC<br>NARC<br>NARC<br>NARC<br>NARC                                  |
| OMGZ      | ω                    | I Earth  | rotation rate              | (RAD/SEC)      | /GLOBAL/(   | 3)  | ADID3A I<br>CRASH I<br>DER3A I<br>EQUA3 I<br>SEINP I<br>MODELA I<br>MODELB I<br>PDBC I<br>PDY3A I<br>SDINP I<br>TOPM I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | OMGZ<br>OMEGA<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ |
| SIRF      | $\Psi_{_{f \Gamma}}$ | I Refere | nce azimuth.               | ( peg )        | /GLOBAL/{   | 68) | GEINP I<br>REU3 I<br>SDINP M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | PSIRF<br>PSIRF<br>PSIRF                                               |
| ARG       |                      | I Packed | array of targets           |                | /GEINP /(*  | )   | GEINP I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | TARG                                                                  |
| XLAMRF    | Pr                   | I Refere | nce latitude.              | (DEĞ)          | /GLOBAL/(   | 4)  | CRASH M<br>GEINP I<br>REU3 I<br>SDINP M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | RHOO<br>XLAMRF<br>XLAMRF<br>XLAMRF                                    |
| YMURF     | $\mu_{_{\Gamma}}$    | I Refere | nce longitude.             | (DEG)          | /GLOBAL/(   | 5)  | CRASH A<br>GEINP I<br>REU3 I<br>SDINP M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | UMUO<br>YMURF<br>YMURF<br>YMURF                                       |
| . UNO 6 . |                      | O File o | f all output data          |                | /.UN06./(\$ |     | BLICOY COOPERATE OF CONTROL OF COOPERATE OF | 06.06.6.06.6.00.00.00.00.00.00.00.00.00.                              |

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```
GEIMP
COMM
Table, Bivariate Data, Sizing (Phase I comm
Ta and processes it
                 PROGRAM GEINP
INPUT ROUTINE
READS IN GLOBAL
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901
       0000
  ARCDAT,
                      READS IN GLOBAL, ARCDAT, TAR
AND BOUNDARY CONDITION DATA
   COMM
COMM
GLOBAL
GLOBAL
               COMMON/GLOBAL/
   GLUBAL
GLUBAL
GLUBAL
GLUBAL
RETAP
ARCDAT
  AREDAT
AREDAT
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AREDAT
AREDAT
AREDAT
            C
              COMN
NOS
PO14
COMN
       C
        C
  GEINP
GEINP
GEINP
   GEINP
PO14
PO14
PO14
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
  10-20-200-
72
73.
74.
            10 IERR=1
WRITE(6,210) MN
60 TO 50
   GEINP
GEINP
GEINP
```

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```
75.
76.
77
   20 IF(G(1)+G(2) NE.0) 50 TO 30 WRITE(6,220) G(1),G(2) IFATAL=.TRUE.
   GEINP
GEINP
GEINP
  30.
  30 CONTINUE

30 CONTINUE

IF (NARC.LT.1) NARC=3

IF (NARC.GT.20) NARC=20

MRITE(6,40) IFACTILUM+1), GR, ER, DMGZ, XLAMRF, YMURF, PSIRF

40 FORMAT(1M1,36X, 45MMCDDNNELL DDUGLAS ASTRONAUTICS CORPANY - WEST/

195X, 29MTABTOP COMPUTER PROGRAM-P1551//5X, 11MBLOBAL DATA/EX,
215MTHIS MILL BE A A 10, 4M RUM//6X, 8MGRAVÍTY=F9.5,14M EARTH RADIUS

3=
           78.
79
80.
  SEINP
NOS
   NOT THE PROPERTY OF THE PROPER
           81.
82.
83.
           84.
85.
86.
87.
89.
90.
91.
  3=
4F12 2,14H ROTAT RATE=E15.6,13H REF. LATIY =F9.4,14H REF. LUNG.
5=F9.4/6%, 9HREF.AZIM=F9.4)
  ç
  I-C SPLINE FIT UNIVARIATE TABLES CALL SPLICO
   11
  READ IN ARC DATA , PROCESS AND STORE ON RANDOM FILE
   50 MM=11
    WRITE(6,60)
60 FORMAT(HI)
    CALL TABING DURMY, 1, ARCDA, 51, RUMMY, 1, ID, MM, 0, IEOD)
    IF(IEOD .EQ. 0) 60 TO 70
    IERR = 1
    WRITE(6,210) RM
    GO TO 140
           93.
94.
95.
96.
97.
98
  SELNP
  GEINP
GEINP
FRAT
   SEINP
SEINP
SEINP
SEINP
   76-
       100.
   146
   GO TO 140

70 D0 80 1=1.51
80 TEMP(1) = ARCDA(1)
CALL FXDAT(1)
CALL FXDAT(1)
CALL WRITMS(9,ARCDA,51,1)
11-A SAVE KEY DPTION FLAGS AND SET NUMBERS
JAF(2)=MACA
JAF(2)=MACA
JAF(3)= JPRO
JAF(4)= MWDB
1F(NARC.Ed.1) SO TO 140
DO 130 IARC=2,NARC
CALL TABINK DUBRY, 1,ARCDA,51,RUMMY,1,ID,IARC+10,0,IEOD)
IF(IEOD.ED.0) 60 TO 90
CALL STPIT(98)

90 CONTINUE
DO 100 I=1,51
IF(ABS(ARCDA(1)) NE. 0.) 80 TO 100
IF(SIGN(1), ARCDA(I)) LT. G.) ARCDA(I)= TEMP(I)

100 CONTINUE
TEOTER DO 1 C
  FRAT
GEINP
GEINP
NOS
    101.
102.
103.
104.
105.
106.
107.
118.
110.
1112.
1113.
114.
  COMN
SEINP
SEINP
FIXED
  C
  FIXED
SEINP
SEINP
FRAT
  146
  967
   SEINP
SEINP
115.
116
117
118
  SEINP
FRAT
   SEINP
  166-
  IF(SIGM(1, ARCDA(1)) .LI. G.

100 CDNTINUE

IF(DTP1.EQ.O.) DTPI=1.

IF(DTP1.EQ.O.) DTNC=1.

110 DD 120 I=1,51

120 TEMP(i) = ARCDA(I)

CALL FXDAT(IARC)

CALL MRITMS(9,ARCDA,51,IARC)

KO=(IARC-1)+4

JAF(KO+1)=JAER

JAF(KO+2)=MEA

JAF(KO+3)= JPRO
JAF(KO+4)= MNOB

130 CONTINUE
  SEINP
POIT
NOS
FRAT
GEINP
FRAT
GEINP
GEINP
FIXED
FIXED
     119.
    120
121.
122.
123.
124.
125.
     127.
128.
129.
     130.
   SEINP
   130 CONTINUE
   140 CONTINUE
111 TEST FOR BIVARIATE TABLES AND BICUBIC SPLIME FIT
DO 155 1-1, MARC
K0=4*(I-1)
IF(JAF(K0+1).WE.2) GD TO 150
CALL BLICO(JAF(K0+2))
   SEI NP
     132
133. €
     134
135
136.
137
   FIXED
GEINP
GEINP
  150-
  SEINP
  150 CONTINUE
IF(JAF(KD+3).WE.2) 60 TD 155
CALL BLICO( JAF(KD+4))
     138.
139.
140.
   SEIMP
FIXED
FIXED
  155-
   155 CONTINUE

IV READ IN SIZING DATA AND SET FLAGS

MN=10
CALL TABIN(OUMMY, 1, SIZ, 70, RUMMY, 1, ID, MM, 0, IEDD)

IF(IEDD.NE.0) GD TO 152
       141.
142.
143.
144.
  FIXED
COMM
FIXED
   Ç
   PH15Z
FH15Z
     145.
   152
```

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```
CALL 1PR(3HS1Z ,S1Z,1,70,0)

1PASS=1
JTYP=$12(42)

1F(51Z(21) E0.0.) $1Z(21)=6.

HUM1=$1Z(50)

10PST6 = $1Z(51)

50 T0 153
   146.
147.
148.
149
150.
151.
  PHISZ
PHISZ
UH
FINI
POW
OS
PHISZ
   153
     153.
                        152 JTYP =0
  PH15Z
   153. 152 JYP =0

154. 153 CONTINUE

155. MN=2

156. C V

157. C READ IN BOUNDARY CONDITION DATA

158 CALL TABINCOUMNY, 1, RUMAY, 1, A, 1000, ID, MN, 0, 1E00)

159. IF(IEOD.NE. 0) GO TO 160

160. IF(III EQ.3) GO TO 170
  PHISZ
GEINP
COMN
GEINP
GEINP
GEINP
GEINP
   160 170
                        160 WRITE(6,210) MM
60 TO 190
    161.
162.
   GEINP
GEINP
  190--
                      163.
164.
165.
166.
167.
168.
171.
172.
174.
175.
176.
177.
   GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
GEINP
190-
                                  RETURN
     180.
                        196 CALL STPIT(99)
   GEINP
   GEINP
GEINP
GEINP
GEINP
    181.
182.
183.
184.
                       200 CALL EXIT
210 FORMAT(26H INPUT ERROR IN PART-CASEI3)
220 FORMAT(25H GLOBAL DATA MISSING GR=E17.8,4H ER=E17.8)
                                  END
```

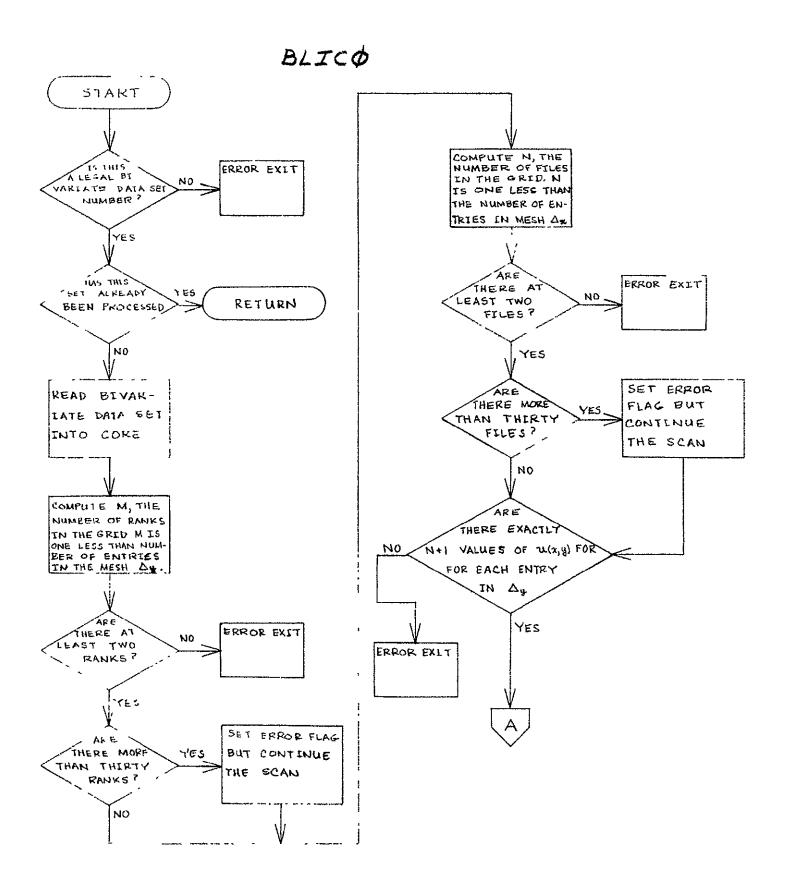
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# SUBRØUTINE BLICØ

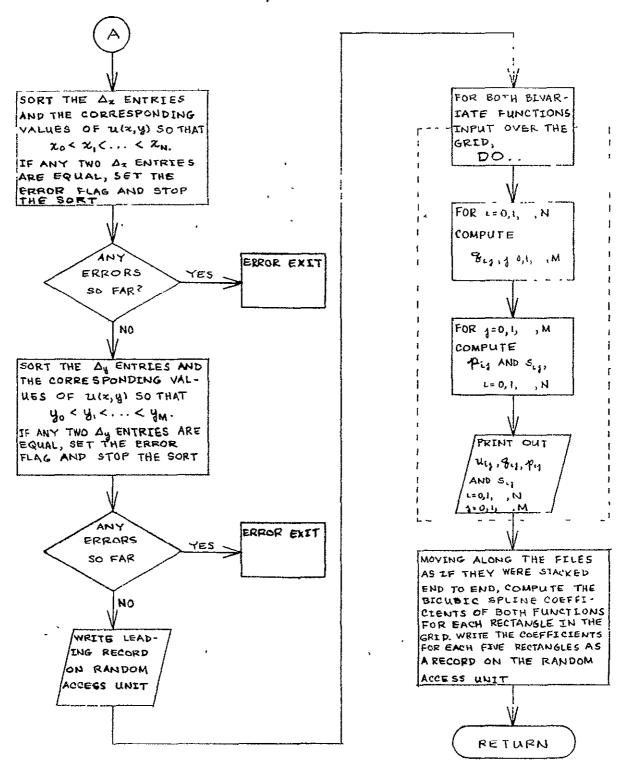
### Subroutine BLICØ

### Purpose

Subroutine BLIC $\phi$  computes bicube spline coefficients and stores them on disc or drum random files.



### BLICO (continued)



| ORIGAN | MAIH           | roce | DESCRIPTION                                                                                           | STORAL    |      |                                                                                                 |                           | USAGE                                                              |
|--------|----------------|------|-------------------------------------------------------------------------------------------------------|-----------|------|-------------------------------------------------------------------------------------------------|---------------------------|--------------------------------------------------------------------|
| SYMBOL | SYMBOL         |      | DESCRIPTION                                                                                           | BLOCK     | LOC  | SUBR                                                                                            | CODE                      | VAR                                                                |
| ALFA   |                | M    | A 31 word array containing the mesh y <sub>0</sub> , y <sub>1</sub> ,,y <sub>n</sub>                  | \BICUBE\( | 235) | BL1CO<br>BLYNE                                                                                  | ri<br>I                   | ALFA<br>MACH                                                       |
| AMAX   | Уm             | 0    | The largest value of the second independent variable of a bivariate table.                            | /BICU8E/( | 61   | BLYNE<br>BLICO                                                                                  | 0                         | AMAX<br>MMAX                                                       |
| MIN    | y <sub>O</sub> | 0    | The smallest value of the second independent variable of a bivariate table.                           | \81CU8E\( | 5)   | BLYNE                                                                                           | 0                         | AINA<br>Minn                                                       |
|        |                | I    | A 31 word array containing the mesh $x_0$ , $x_1$ ,, $x_n$                                            | /BICUBE/( | 204) | BLICO<br>BLICO<br>BLYNE                                                                         | ]<br>M<br>]               | F<br>Mach<br>Alfa                                                  |
| ס      |                | I    | A four word array containing the basic deck, reference run, case and part case numbers in that order. | /GLOBAL/( | 21)  | BLICO<br>FRENCH<br>GEINP<br>PADS1<br>PRINT<br>SDINP<br>TOPM<br>VEHDF                            | 1<br>1<br>D<br>1          | IB<br>IB<br>IB<br>ID<br>ID<br>ID                                   |
| F      |                | W    | Last rank in the grid in which interpolation occurred.                                                | /BICUBE/( | 7)   | BLICO<br>BLYNE<br>INBVA                                                                         | M<br>M<br>M               | IF<br>IR<br>IR                                                     |
| FATAL  |                | P    | Fatal error fisg.                                                                                     | /GLDBAL/( | 17)  | BLICO<br>GEINP<br>PADSI<br>SDINP<br>SPLICO<br>STPIT<br>TOPM                                     |                           | IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL           |
| FMAX   |                | M    | Total number of ranks in grid.                                                                        | /BICUBE/( | 8)   | BLICO<br>BLYNE<br>INBVAC                                                                        | M<br>I<br>I               | IFMAX<br>IRMAX<br>IRMAX                                            |
| REC    |                | 15   | Logical record on IUNIT that contains spline coefficients for rectangle IRECT.                        | /BICUBE/( | 11)  | BLICO<br>BLYNE<br>INBVA                                                                         | PS<br>PS<br>D: PS         | IREC<br>IREC<br>IREC                                               |
| RECT   |                | M    | Grid rectangle associated with IR and IF.                                                             | /BICUBE/( | 10)  | BLICO<br>BLYNE<br>INBVA                                                                         | n<br>n<br>n c             | IRECT<br>IRECT<br>IRECT                                            |
| RMAX   | N              | m    | Total number of files in grid.                                                                        | /BICUBE/( | 4)   | BLICO<br>BLYNE<br>INBVAI                                                                        | M<br>I<br>I C             | IRMAX<br>IFMAX<br>IFMAX                                            |
| UNIT   |                | m    | Logical unit number on which bicubic spline coefficients are stored for this table.                   | /BICUBE/( | 9)   | BLICO<br>BLYNE<br>INBVA                                                                         | M<br>1<br>0 1             | TINUT<br>TINUT<br>TINUT                                            |
| ACH    |                | M    | A 31 word array containing the mesh $\mathbf{x}_0$ , $\mathbf{x}_1$ ,, $\mathbf{x}_n$                 | /BICUBE/( | 204) | BLICO<br>BLICO<br>BLYNE                                                                         | 1<br>M<br>1               | F<br>Mach<br>Alfa                                                  |
| XAMI   | x N            | 9    | The largest value of the first independent variable of a bivariate table.                             | /BICUBE/( | 2)   | BLICO<br>BLYNE<br>INBVAI                                                                        | O<br>I<br>D I             | XAMM<br>XAMA<br>XAMA                                               |
| MIM    | <sup>x</sup> o | M    | The smallest value of the first independent variable of a bivariate table.                            | /BICUBE/( | 1)   | BLICO<br>BLYNE<br>INBVA                                                                         | I                         | MMIN<br>AMIN<br>AMIN                                               |
| 3D1    |                | I    | Angle to radian conversion, .01745329252                                                              | /DATA /{  | 3)   | BLICO<br>DERSA<br>FNTG<br>GUISA<br>MODELI<br>PADSI<br>PROPBI<br>PROPBI<br>REUS<br>SDINP<br>SOMG | 1<br>I<br>A I<br>B 1<br>D | RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI |

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| FORTRAN<br>SYMBOT | MATH<br>SYMBOL | CODE    | DESCRIPTION                               | 510F43<br>8LO,K | F<br>LÜu | 2 14 H D D I                                                                                                         |            | VAR |
|-------------------|----------------|---------|-------------------------------------------|-----------------|----------|----------------------------------------------------------------------------------------------------------------------|------------|-----|
| т                 |                | 1 A 160 | word array containing logical record IREC | /BICUBE/(       | 44)      | BLICO<br>BLYNE<br>INBVAD                                                                                             | 1 T<br>1 T |     |
| . UN06.           |                | O File  | of all output data                        | /.UN06./(\$     | ,        | BLICO<br>BNDRYC<br>CRASH<br>FREACH<br>FREACH<br>FREACH<br>GEINP<br>HUNDIIT<br>ITERB<br>MODEL<br>MPSI<br>OUT<br>PRINT |            |     |

```
SUBROUTINE BLICO(ISET)
LOGICAL IFATAL, BONE(1), UNEQUL, RECYC
REAL MACH(1), MSAVE, MMIN, MMAX
COMMON/ARCOA!
   BLICO
BLICO
BLICO
ARCDAT
1.234567.890.1123.1567.8.122.223.5.67.
                                       28
29
30
31.
32.
33.
LASY 1. 8 + 0., .5. 6./.

10 FORMAC(1HO, 9HTHE VALUE, 13,49H IS AN ILLEGAL DATA SET FOR BIVAR *IATE DATA *)

20 FORMAC(1HO, 39HTHE BIVARIATE DATA DATA SET NO., 13,14H WAS **NOT INPUT)

30 FORMAC(1HO, 56HLESS THAN 3 TABLES OF BIVARIATE DATA WERE INP **UT IN DATA SET, 13)

40 FORMAC(1HO, 67HMORE THAN 31 TABLES OF BIVARIATE DATA WERE INP **PUT IN DATA SET, 13)

50 FORMAC(1HO, 77HLESS THAN 6 ENTRIES PER TABLE OF BIVARIATE DATA WERE INPUT IN DATA SET, 13)

60 FORMAC(1HO, 78HMORE THAN 62 ENTRIES PER TABLE OF BIVARIATE DATA WERE INPUT IN DATA SET, 13)

70 FORMAC(1HO, 26HBIVARIATE DATA TABLE, 13, 13H IN DATA SET, 413, 13H IS TOO SHORT)

80 FORMAC(1HO, 26HBIVARIATE DATA TABLE, 13, 13H IN DATA SET, 413, 12H IS TOO SHORT)

80 FORMAC(1HO, 26HBIVARIATE DATA TABLE, 13, 13H IN DATA SET, 13)

100 FORMAC(1HO, 7HARG 1 = E15.7, 27H IS NOT UNIQUE IN DATA SET, 13)

110 FORMAC(1HO, 31HBIVARIATE DATA (DATA SET, 13)

120 FORMAC(1HO, 31HBIVARIATE DATA (DATA SET, 13)

130 FORMAC(1HI, 16HFIRST FUNCTION)

130 FORMAC(1HI, 16HFIRST FUNCTION)

140 FORMAC(1HO, 8X, 7HARG 1 = 8E14.6)

150 FORMAC(1HO, 8X, 7HARG 1 = 8E14.6)

150 FORMAC(1HO, 27H*****FATAL IMPUT ERROR******)

1F(6.LE.ISET.AND ISET.LE.9) SO TO 180

IFITAL - TRUE.

WRITE(6,170)

WRITE(6,10) ISET

RETURN

180 IF(DONE(ISET - 5)) RETURN

DONE(ISET - 5) = TRUE.
   FIXED
FIXED
FIXED
FIXED
  FIXED
FIXED
FIXED
FIXED
FIXED
   FIXED
FIXED
FIXED
FIXED
   FIXED
FIXED
FIXED
BLICO
BLICO
BLICO
BLICO
BLICO
  180-
                                     BLICO
BLICO
68.
69.
70.
71.
72.
73.
74.
75.
   BLICO
   BLICO
BLICO
BLICO
BLICO
BLICO
   ,0, 1E00)
   190-
```

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```
190 NT = IU - 1

IFMAX = NT - 1

IF(2 .LE. IFMAX) 80 TO 20D

IFATAL = .TRUE.

WRITE(6,170)

WRITE(6,30) ISET

RETURN
                                     76
77.
78.
79.
80.
  BLICO
  BLICO
BLICO
BLICO
BLICO
   200-
                                     81.
82
  BLICO
BLICO
  RETURN '
200 IF(IFMAX .LE. 30) GO TO 210
IFATAL = .TRUE.
WRITE(6,170)
WRITE(6,40) ISET
                                     83.
84.
85.
86.
  BLICO
BLICO
BLICO
BLICO
   210
  210 NEWT = LASTAB - 1
NUPT = MENT/MT
IRMAX = NUPT/Z - 1
NUPT = IRMAX + 1
IF(Z .LE IRMAX) GO TO 220
IFATAL = .TRUE.
WRITE(6,170)
WRITE(6,50) ISET
RETURN
  BLICO
BLICO
BLICO
BLICO
BLICO
                                      87.
                                     88.
90.
91.
93.
95.
   220-
  BLICO
BLICO
BLICO
   RETURN
  220 IF(IRMAX .LE. 30) GO TO 230
IFATAL = .TRUE.
WRITE(6,170)
WRITE(6,60) ISET
                                     96.
97
  BLICO
BLICO
BLICO
BLICO
   230-
                                     98.
  230 UNEQUL = .FALSE.

DO 260 I = 1, IFMAX

IF(1U(I + 2) - IU(I + 1) - NWPT) 240,260,250
  BLICO
BLICO
BLICO
                                    100.
                                    101.
102.
   240-7250-7260-
  240 UMEQUL = .TRUE.
WRITE(6,170)
WRITE(6,70) I, ISET
GO TO 260
                                   103.
104.
105.
106
  BLICO
BLICO
BLICO
BLICO
   260-
                                   107
108
109
  250 UNEQUL = .TRUE.
WRITE(6,170)
WRITE(6,80) I, ISET
  BLICO
BLICO
BLICO
                                   110.
  260 CONTINUE
IF(LASTAB - IU(IU) - NWPT) 270,290,280
  BLICO
BLICO
   270-1280-1290
  270 UNEQUL = .TRUE.

WRITE(6,170)

WRITE(6,70) MT, ISET

60 TO 290
  BLICO
BLICO
BLICO
BLICO
                                   112
                                   113
114.
115
   290
  280 UNEQUL = .TRUE.
WRITE(6,170)
WRITE(6,80) NT, ISET
                                   116.
   BLICO
                                   117.
   BLICO
BLICO
  290 IF(.NOT.UNEQUL) 60 TO 300
IFATAL = .TRUE.
RETURN
   300-
                                   119
   BLICO
                                   120.
121
  BLICO
BLICO
  300 RECYC = .FALSE.

DO 340 I = 1, IRMAX

IF(MACH(I + 1) - MACH(I)) 310,330,340
                                   122
  BLICO
                                   123.
124
  BLICO
BLICO
   IF(MACH(1 + 1) - MACH(1))

310 IF(IFATAL) SO TO 340

RECYC = TRUE.

MSAVE = MACN(1)

MACH(1) = MACH(1 + 1)

MACH(1) = MACH(1 + 1)

MACH(1 + 1) = MSAVE

DO 320 J = 1, MT

L = IU(J + 1) + 2+I + MT

CLSAVE = U(L - 1)

CDSAVE = U(L + 1)

U(L - 1) = U(L + 1)

U(L + 1) = CLSAVE

320 U(L + 2) = CDSAVE

GO TO 340

330 IFATAL = .TRUE.
   316 330 7340
                                  125.
127.
128.
129.
130.
131.
132.
133.
134.
135.
  BLICO
   349-
  BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
                                    138.
   BLICO
  340
  330 IFATAL = .TRUE.

RECYC = FALSE.

WRITE(6,170)

WRITE(6,90) MACH(1), ISET
   BLICO
BLICO
BLICO
                                   139
140.
                                   141.
142.
                                   143.
   340 CONTINUE
   BLICO
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```

145

\*\*\*

```
IF(RECYC) SO TO 30D
IF(IFATAL) RETURN
   BLICO
BLICO
  300-
  146.
147
148
   RECYC = .FALSE.
00 390 I = 1, IFMAK
1F(ALFA(1 + 1) - ALFA(1)) 360,380,390
  BLICO
BLICO
BLICO
  390-
   360-380-
  IF(ALFA(I + 1) - ALFA()

360 IF(1FATAL) 60 TO 390
RECVC = .TRUE.
ASAVE = ALFA(I)
ALFA(I) = ALFA(I)
ALFA(I + 1) = ASAVE
IBASE = IU(I + 1) + MT
DO 370 J = 1, NMPT, 2
K = J + IBASE
L = K + NMPT
CLSAVE = U(K)
CDSAVE = U(K)
U(K) = U(L)
U(K + 1) = U(L + 1)
U(K + 1) = U(L + 1)
U(L + 1) = CDSAVE
370 U(L + 1) = CDSAVE
50 TO 390

380 IFATAL = .TRUE.
   149
151.
152.
153.
156.
156.
158.
   BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
   390
   160.
161.
162.
163.
164.
   390
   380 IFATAL = .TRUE.
RECYC = .FALSE.
WRITE(6,170)
WRITE(6,100) ALFA(1), ISET
  166.
166.
167.
  BLICO
BLICO
BLICO
  168
   WRITE(6,100) ALFA(1), ISET

390 CONTINUE
IF (RECYC) GO TO 350
IF (IFATAL) RETURN
IF (NUBB .GE. 0) GO TO 399
L = NT
HANT = HENT + NT + 1
DO 398 I = 1, NPPT
L = L + 2
AL = MACH(1)*RDI
SIMAL = SIN(AL)
COSAL = COS(AL)
DO 397 J = L, NANT, NMPT
CN = U(J)
CX = U(J*1)
U(J) = CM**COSAL - CX**SINAL
U(J*1) = CM**SINAL + CX**COSAL
397 CONTINUE
399 CONTINUE
  BLICO
   BLICO
BLICO
BLICO
JULY28
SEP18
SEP18
JULY28
JULY28
JULY28
JULY28
JULY28
JULY28
  169.
170.
171.
   350
  172
173.
174.
175.
   1399
  176.
177.
178.
179.
   SEP18
JULY28
JULY28
JULY28
   182.
   183
184.
185.
   JULY28
JULY28
JULY28
   397 CONTINUE
398 CONTINUE
AMIM = ALFA
AMAX = ALFA(MT)
MAIN = MACH
MAX = ALFA(MT)
MAIN = MACH
MAX = ALFA(MT)
MAIN = MACH
MAX = MACH(NPPY)
IUNIT = 1SET + 27
CALL WRITASCIUNIT, MAIN, 273, 1)
DD 400 I = 1, MEMI
P(I) = 0.
Q(I) = 0.
WRITE(6,110) ISET
DD 430 IC = 1, 2
MRITE(6,110) ISET
DD 430 I = IC, MMPT, 2
K = IU + J
CALL MOMENT(ALFA, IFMAX, U(K), P(J), NMPT)
CALL MOMENT(MACH, IRMAX, P(J), S(J), 2)
QU 430 I = 1, MPPT, 8
ILIM = MINOC(I + T, NPPT)
II = IC - MMPT + 2+(I - 1)
IK = IU + II
IMAX = IIMAX + IU
DD 430 J = 1, MT, 11
IF(IC .EQ. 1) WRITE(6,120)
IF(IC .EQ. 2)WRITE(6,130)
WRITE(6,140) (MACH(IJ), IJ = I, ILIM)
  186.
   187.
188.
189.
190
191.
192.
193.
194
195.
196.
197.
   JULY28
   BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
BLICO
  201.
202.
203.
204.
205
  BLICD
BLICO
BLICO
BLICO
   205
206
207.
208.
209.
210.
211.
212.
   BLICO
BLICO
BLICO
BLICO
   BLICO
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BLICO
BLICO
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```

```
JLIM = MINO(J + 10, MT)

DO 430 L = J JLIM

IK = IK + NUPT

II = II + NUPT

IIMAX = IIMAX + NUPT

IKMAX = IKMAX + NUPT

MRITE(6,150) ALFA(L) (U(IJ), IJ = IK, IKMAX, 2)

WRITE(6,160) (P(IJ), IJ = II, IIMAX, 2)

WRITE(6,160) (Q(IJ), IJ = II, IIMAX, 2)

430 WRITE(6,160) (S(IJ), IJ = II, IIMAX, 2)

L = 0
21189.
21212012225478901.
2222228901.
22222822333456.
22333456.
22333456.
224445.
224445.
224445.
   8LICO
8LICO
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  440-
   AXI4 = AX6/2.

AXI6 = AX8

IRS = IRM1

440 Y = ALFA(IF + 1) - ALFA(IF)

AY5 = -1./Y

AY6 = -Y/3.

AY7 = -AY5

AY8 = AY6/2.

AY14 = -1./(6 *Y)

AY16 = -AY14

IXP = 2*IRM1 + NWPT*(IF - 1)

DO 450 IC = 1, 2

K = K + 16

IX = IXP + IC

L = IX + IU

XK1 = U(L)

XK2 = U(IX)

XK5 = P(IX)

XK6 = S(IX)

IX = IX + 2

L = IX + 1U

XX3 = U(L)

XX7 = P(IX)

XX8 = S(IX)

IX = IX + 2

L = IX + 1U

XX9 = U(L)

XK10 = Q(IX)

XK10 = Q(IX)

XK13 = P(IX)

XK14 = S(IX)

IX = IX + 2

L = IX + 1U

XX9 = U(L)

XK12 = Q(IX)

XK14 = S(IX)

IX = IX + 2

L = IX + 1U

XX11 = U(L)

XX15 = P(IX)

XX16 = S(IX)

IX = IX + 2

L = IX + 1U

XX11 = U(L)

XX16 = S(IX)

IX = IX + 2

L = IX + 1U

XX11 = U(L)

XX16 = S(IX)

IX = IX + 2

L = IX + IU

XX11 = IX + 2

L = IX + IU

XX11 = IX + 2

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L = IX + IU

XX11 = IX + 2

L = IX + IU

XX11 = IX + 3

IX = IX + 3

IX = IX + 3

IX = IX + 10

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# SUBRØUT I NE BNDRYC

#### Subroutine BNDRYC

## Purpose

This subroutine packs boundary condition data (both initial and target input data) into an ordered packed array which will be stored in a random access file.

## Description

The input to this routine is the array ARR which is an unordered packed representation of the input initial and target conditions. The main function of the routine is to sort the unordered data into a matrix array, concurrently counting the numbers of initial and target conditions in each arc. The number of initial and target conditions is stored by the calling program (GEINP) in arrays ITAB and KTAB respectively.

| FORTHAN MATH<br>Symbol Symbol           | COBE                                   | DESCRIPTION                                             | STORAC<br>BLULK | LOC      | <u> </u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | NF USAGE<br>DE VAR |
|-----------------------------------------|----------------------------------------|---------------------------------------------------------|-----------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| *************************************** | ************************************** |                                                         |                 |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |
| ACD                                     | W                                      | Intermediate unpacked boundary condition array          | /BNORYC/(#      | <b>)</b> | BADRYC M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ACD                |
| ANC                                     | 넵                                      | Intermediate unpacked boundary condition array          | /BNDRYC/( *     | )        | BNDRYC W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ANC                |
| ARR                                     | 1                                      | Array of Input Initial and target conditions            | /BNDRYC/(+      | . )      | BNDRYC I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ARR                |
| BNARR                                   | 0                                      | Packed boundary condition array output on random file   | /BNORYC/(+      | • )      | BNDRYC 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | BNARR              |
| ILOC                                    | 1                                      | Index of array ARR where the boundary conditions start  | /BNDRYC/(*      | , )      | BNORYC I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | IFOC               |
| ITAB                                    | M                                      | Array of number of initial or target conditions per arc | /BNDRYC/(       |          | BNDRYC M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ITAB               |
| M                                       | u                                      | Keep track of location in BNARR array                   | /BNDAVC/(+      | . )      | BNDRYC M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A                  |
| YZ                                      | ш                                      | Array of unpacked boundary condition values             | /BNDRYC/(+      |          | BNDRYC W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |
| UNO6.                                   | 0                                      | File of all output data                                 | /.UN06./(s      | ,        | BLICO OBANDARYC |                    |

```
SUBROUTINE BNDRYC(ARR, ILOC, ITAB, BNARR, N, IEND, IFATAL)

ARR IS THE INPUT ARRAY CONTAINING BNDRY COND. INPUT
LOC IS THE INDEX OF ARRAY IRR WHERE THE BNDRY COND. INPUT START
ITAB IS THE ARRAY WHOSE VALUES ARE THE ADRBER OF INITIAL
CONDITIONS SPECIFIED IN EACH ARC
BNARR IS AN ARRAY CONTAINING IC VALUES AND CLASSIFICATIONS
FOR EXAMPLE CLASSIFICATION CODES ARE*

0. CONTINUOUS
1. KNOWN
2. OPTIMIZED
3. ESTIMATED
4. UNKNOWN
5. DISCONTINUITY IN MASS (WEIGHT)
6. WEIGHT DISCONTIUTY COMPUTED IN WIDROP
15 BRANCH TO STAGE 5 (FOR EXAMPLE)
BNDRY
BNDRY
LOGICAL IFATAL
BORDY
BNDRY
BND
          12345678901123456789012345678901.
                                  LOGICAL IFATAL
BIMENSION ITAB(1), BNARR(1), ARR(1), ACD(10,20), YZ(10,20), ANC(10,20),
1AVA(10,20)
EQUIVALENCE (ACD, ANC), (AVA, YZ)
  BNDRY
  BNDRY
BNDRY
COMN
COMN
  I ZERO ARRAYS
DO 10 I=1,200
10 ACD(I)=0.
WRITE(6,20)
20 FORMAT (56H1
15)
  BNORY
BNDRY
BNDRY
BNDRY
   PRELIMINARY SCAN OF BOUNDARY CONDITION
   BNDRY
COMN
COMN
  EXTRACT IC DATA FROM ARR AND LOAD INTO MATRICES ,ALSO COUNT NO OF ICS AND STORE IN ITAB
  COMM
  KCNT =0
  BNDRY
BNDRY
            32
  J=1LOC

30 IF(J.GT YEND) 60 TO 50

IA1= ARR(J)+.5

ICD1=ARR(J+1)+.5

IF(ARR(J+2).NE.O.)

IITAB(IA1)= ITAB(IA1)+1

ACD1 ICD1, IA1) = ARR(J+2)

YZ (1CD1, IA1) = ARR(J+3)

KCNI = KCNT +1

40 J = J +4

60 TO 30
           33.
34.
35.
36.
37.
38.
  BNDRY
  BNDRY
  BNDRY
  BNDRY
  BNORY
BNORY
BNORY
             41.
42.
  BNOSY
  BNDRY
            43.
45.
45.
47.
49.
51.
51.
  50 CONTINUE
  BNORY
  COMM
  III CHECK FOR ICS IN EACH ARC AND PUT CODES IN BMARR PACK IC DATA IN BMARR M=0
DD 100 I=1,20
IF(IIAB(I).EQ.0)60 TQ 100
JC=ITAB(I)
DD 90 K=1,10
IF(ACD(K,I).EQ.0) 60 TO 90
60 BMARR(M+1)= ACD(K,I)
70 BMARR(M+2) = X
M=M=3
  COMM
BNDSY
BNDSY
  BNORY
  BADRY
BADRY
  100-
  BNDRY
  BNORY
BNDRY
BNDRY
  90-
           53.
54.
55.
56.
59.
  RNDRY
  BNDRY
COAN
COAN
   III-A TEST FOR TOO MANY ICS
IF(M GT.N) GO TO 110
  BNDRY
   110-
            60,
  90 CONTINUE
  BNDRY
            61.
62.
   100 CONTINUE
60 TO 140
  BNDRY
  BNDRY
   140
            63.
64.
65.
66.
   110 WRITE(6,130)
IFATAL= .TRUE.
120 WRITE(6,150)
  BNDRY
  BNORY
  RNDRY
  RETURN
130 FORMAT(3X,33H TO MANY IC 5 SPECIFIED FOR ARRAY)
  BNORY
           68.
69
70.
71
72.
   140 WRITE(6,160)
150 FORMAT(39H BAD SCAN OF INPUT INITIAL CONDITIONS)
160 FORMAT(39H GOOD SCAN OF INPUT INITIAL CONDITIONS)
RETURN
  BNORY
  BADRY
  TARSET CONDITION SCAN AND PACKING
   IV
  CORN
```

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```
COMM
BNORY
BNORY
BNORY
BNORY
COMM
COMM
73.
74.
75.
76.
78.
80.
81.
82.
83.
85.
86.
                                       ARR IS THE IMPUT ARRAY ILOC IS THE LOCATION IN ARR WHERE TARGET INPUTS START KIAB IS THE ARRAY OF AD OF TARGETS PER ARC TARGETS ARD TARGET CLASSIFICATIONS IEND IS LAST WORD IN ARR ASSOCIATED WITH TARGETS ENTRY TARGEM
                  C 19-8 E-
   BNDRY
  BNDRY
COMM
COMM
COMM
COMM
BNDRY
BNDRY
                                    IV-6 EXTRACT DATA FROM IMPUT ARRAY AND PUT IN MATRICES
ALSO COUNT 40 OF TARGETS IN EACH ARC
L-TLOC
J-TLOC
                           J=1LOC

180 F(J.GT IEND) SO TO 196

IA1= ARR(J)+.5

ITAB(IA1) = ITAB(IA1)+1

KK= ITAB(IA1)

ARC(KK, IA1) = (ARR(J+1)*1.E6 + ABS(ARR(J+2))*SIGN (1.,ARR(J+2))

AYA(KK, IA1) = ARR(J+3)

J= J+4

GO TO 180
        89.
90.
91.
92.
93.
94.
95.
   BNDRY
  BNDRY
BNDRY
BNDRY
BNDRY
   RADRY
  BNDRY
 96.

97.

98. C

99. C

100.

101.

102.

103.

104.

105.

106.

107.

108.
   BNDRY
                           190 CONTINUE
  BNDRY
COMN
COMN
BNDRY
BNDRY
BNDRY
BNDRY
BNDRY
                           V PACK DATA IN TARS ARRAY
M=1
DD 21G I=1,20
IF(ITAB(1).EG.0) SO TO 210
K= ITAB(I)
DD 20G JK=1,K
BMARR(M) = AMC(JK,I)
BMARR(M+1)=AWA(JK,I)
H=N+2
20G CONTINUE
   210-
   BNDEY
   BADRY
BADRY
                            210 CONTINUE
MRITE(6,220)
220 FORMAT(32H SOOD SCAN OF TARGET CONDITIONS)
RETURN
END
     169.
110.
111.
112.
   BNDRY
   BADRY
BADRY
BADRY
   BHDRY
```

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# SUBROUTINE MOMENT

```
SUBROUTINE MOMENT(X, ILIM, Y, Z, KINK)
OIMEMSION X(1), Y(1), Z(1), Q(50), U(50)
Q = 0.
U = 0.
K = 1
KP1 = 1 + KINK
DD 10 I = 2, ILIM
IM1 = I - 1
KM1 = K
KM1 = K
KM1 = KP1 + KINK
XI = X(1)
YK = Y(K)
H1 = XI - X(IM1)
H2 = X(1 + 1) - XI
H1PH2 = M1 + H2
XLAM = H2/H1PH2
XMU = 1. - XLAM
D = 6./H1PH2*((Y(KP1) - YK)/H2 - (YK - Y(KM1))/H1)
P = XMU=D(IM1) + 2.
Q(I) = -XLAM/P
10 U(I) = (D - XMU*U(IM1))/P
L = ILIM
DO 20 I = 2, ILIM
Z(K) = Q(L)*Z(KP1) + U(L)
KP1 = K
K = K - KINK
Z0 L = L - 1
RETURN
END
```

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# SUBRØUTINE SPLICØ

# Subroutine SPLICØ

# Purpose

Subroutine SPLIC $\phi$  computes spline fit coefficients for univariant tables.

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                                                                                                                                                                                     | STCRAG<br>BLOCK | LOC   | SUBROUTINE<br>SUBR CODE                                                                  |                                                          |
|-------------------|----------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------|------------------------------------------------------------------------------------------|----------------------------------------------------------|
| IFATAL            |                | m.   | Fatal error flag.                                                                                                                                                                                               | /GLOBAL/(       | 17)   | GEINP O<br>PAOS1 I<br>SOINP M<br>SPLICO M<br>STPIT O                                     | IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL |
| LOCF              |                | M    | A 50 mord array that corresponds to tables 1 thru 50. Each entry is an integer that points to the last value of the independent variable of the corresponding table.                                            | /TABLE /(       | 1401) | SPLICO M<br>SPLICO M<br>SPLIZ I<br>SPLIZ I<br>SPLYNE I<br>SPLYNE I<br>THRUP O            | LOCF<br>Z<br>LOCF<br>Z<br>LOCF<br>Z                      |
| LOCI              |                | M    | A 50 word array that corresponds to tables 1 thru 50. Each entry is an integer that points to the initial value of the independent variable of the corresponding table. A zero entry indicates table not input. | /TABLE /(       | 1)    | SPLICO M<br>SPLICO M<br>SPLIZ I<br>SPLIZ I<br>SPLYNE I<br>SPLYNE I<br>THRUP I<br>THRUP O | X<br>FOCI<br>X<br>FOCI<br>X<br>FOCI<br>X                 |
| LOCL              |                |      | A 50 word array that corresponds to tables 1 thru 50. Each entry is an integer that indicates the last interval in which interpolation of the corresponding table occured.                                      | /TABLE /(       | 701)  | SPLICO M<br>SPLIZ M<br>SPLIZ I<br>SPLYNE M<br>SPLYNE I                                   | A<br>FOCF<br>A<br>FOCF<br>A<br>FOCF                      |
| NT                |                | Ħ    | Largest univariant table number in this case.                                                                                                                                                                   | /GLOBAL/(       | 66)   | SPLIZ I                                                                                  | NT<br>NT<br>NT                                           |
| X                 |                | М    | A 50 word array that corresponds to tables 1 thru 50. Each entry is an integer that points to the initial value of the independent variable of the corresponding table. A zero entry indicates table not input. | /TABLE /(       | 1)    | SPLICO M<br>SPLIZ I<br>SPLIZ I<br>SPLYNE I<br>SPLYNE I                                   | X<br>LOCI<br>X<br>LOCI<br>X<br>LOCI<br>X<br>LOCI<br>X    |
| Y                 |                | M    | A 50 word array that corresponds to tables 1 thru 50 Each entry is an integer that indicates the last interval in which interpolation of the corresponding table occured.                                       | /TABLE /(       | 701)  | SPLICO O<br>SPLICO M<br>SPLIZ M<br>SPLIZ I<br>SPLYNE M<br>SPLYNE I<br>THRUP O            | 4<br>FOCF<br>A<br>FOCF<br>A<br>FOCF                      |
|                   |                | M    | A 50 word array that corresponds to tables 1 thru 50 Each entry is an integer that points to the last value of the independent variable of the corresponding table.                                             | /TABLE /(       | 1401) | SPLICO M<br>SPLIZ I<br>SPLIZ I<br>SPLYNE I                                               | LOCF<br>Z<br>LOCF<br>Z<br>LOCF<br>Z                      |



| SYMBOL | MAIH<br>Symbol | CODE      | DESCRIPTION     | S 1 (HAGE<br>BLOUK LOU | SUBACUTIN<br>Suba coo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
|--------|----------------|-----------|-----------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| ONU    |                | 0 File of | ali output data | /.UNO6./(\$)           | BORGER TO BE RECORDED |  |

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SPLICO

```
SUBROUTINE SPLICO
LOGICAL IFATAL
COMMON /GLOBAL/G(66) /TABLE/T(210G) /TBLE/TBLE(1) /LASTAB/LASTAB
OIMENSION ITBLE(1), LOCI(1), LOCI(1), LOCF(1), X(1), Y(1), Z(1)
EQUIVALENCE (ITBLE, TBLE), (IFATAL, $(17)), (LOCI), (V, LOCL), (Z, LOCF), (MT, $(66))
10); (LOCF, T(1401)), (X, LOCI), (Y, LOCL), (Z, LOCF), (MT, $(66))
20 FORMAT(1HO, 13H FATAL INPUT PERGOR)
10F THE LARGEST TABLE NUMBER/77H AND THE NUMBER OF POINTS IN ALL
20F THE TABLES MUST BE LESS THAN OR EQUAL TO/54H 700. IN THIS IN
3STANCE, THE LARGEST TABLE NUMBER IS, I3, 19H, AND THE NUMBER OF/
433H POINTS IN ALL OF THE TABLES IS, I3, 19H, AND THE NUMBER OF/
433H POINTS IN ALL OF THE TABLES IS, I3, 19H, AND THE NUMBER OF/
433H POINTS IN ALL OF THE TABLES IS, I3, 19H, AND THE NUMBER OF/
437H DISTINCT.)
40 FORMAT(1HO, 13H IN TABLE ND., I3, 14H, THE POINT X=, E14.7, 17H I
1S NDT DISTINCT.)
40 FORMAT(1HO, 26X, 9HTABLE ND., 13//1H, 2HX=,E14.7, 5X, 5HF(X)=,
NT = 17BLE - 1
1FFNT.GT.O) GO TO 45
NT = 0
PETENDE
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SEP
  1.23 45.67.890.1123.115.67.890.1123.
  45
  NT = 0
RETURN
   45 CONTINUE
NP = (LASTAB - 1)/2
LAST = NT + NP
IF(LAST . LE . 700) 60 TO 50
IFATAL = .TRUE.
MRITE(6,10)
URITE(6,20) NT, NP
RETURM
  SEP18
SPLICO
SPLICO
SPLICO
  21.
22.
23.
24.
25
26.
27.
  50
  SPLICO
SPLICO
SPLICO
SPLICO
  WRITE(6,20) NT, NP
RETURN

50 DD 60 I = 1, NT
LOC((1) = 0
LOC((1) = 0

60 LOCF(1) = 0

J = NT + 1
K = NT

DD 70 I = J, LAST
K = K + 2
X(I) = TBLE(K)
Y(I) = TBLE(K)
Y(I) = TBLE(K + 1)

70 Z(I) = 0.
LAST = NT
NEXT = LAST + 1
DD 110 I = 1, NT
K = I + 1
LOCO = ITBLE(K)
IF(LOCO = EO 0) 60 TO 110
LOCI(I) = NEXT
LOCL(I) = NEXT
LOCL(I) = NEXT
IF(I LT. NT) 60 TO 80
LAST = NT + NP
SO TO 100

80 DD 90 J = K, NT
  SPLICO
SPLICO
SPLICO
SPLICO
  29.
30.
31.
32.
33.
35.
36.
37.
38.
  SPLICO
SPLICO
SPLICO
SPLICO
  SPLICO
SPLICO
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SPLICO
  SPLICO
SPLICO
SPLICO
SPLICO
  SPLICO
SPLICO
SPLICO
SPLICO
  110-
  86-
  SPLICO
SPLICO
   1100-
   80 00 90 J = K, NT
LOCA = ITBLE(J + 1)
IFILOCA EQ 0) 60 TO 90
LAST = LAST + (LOCA - LOCO)/2
60 TO 100
  51.
52
53
54
55
  SPLICO
  SPLICO
SPLICO
SPLICO
SPLICO
  100-
  56.
   90 CONTINUE
  SPLICO
  57
58.
  100 LOCF(I) = LAST
NEXT = LAST + 1
  SPLICO
SPLICO
  SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
   110 CONTINUE

DO 170 IT = 1, NT

11 = LOCI(IT)
  59.
60.
61.
62.
64.
65.
  I = LUCI(II)
IF(II .EQ. 0) SO TO 170
IF = LOCF(IT)
IF(II .EQ. IF) SO TO 160
IIP1 = II + 1
   170-
  120 IRECYC = 0

DD 150 I = 11P1, IF

IRI = I - 1

XS = X(IRI)

XI = X(I)

IF(XI - X5) 130,140,150
  SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
  66.
67.
68.
69.
70.
  130-
   140-
   150
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```

(<sup>5</sup>)

```
130 YS = Y(IM1)
    X(IM1) = XI
    Y(IM1) = Y(I)
    X(I) = XS
    Y(I) = YS
    IF( NOT.IFATAL) IRECYC = 1
    GO TO 150

140 IFATAL = TRUE.
    IRECYC = 0
    WRITE(6,10)
    WRITE(6,30) IT, XI

150 CONTINUE
    IF(IRECYC.GT 0) GO TO 120
    IF(IFATAL) GO TO 160
    IFMII = IF - II
    IF(IFMII L 2) GO TO 160
    CALL MOMENT(X(II), IF M II, Y(II), Z(II), I)

160 WRITE(6,40) IT, (X(IJ), Y(IJ), Z(IJ), IJ = II
   SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
72
73.
74.
75.
76.
77.
81.
82.
83.
84.
85.
88.
88.
88.
   SPLICO
SPLICO
SPLICO
SPLICO
   SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
SPLICO
   120-
  166
89.
                             160 WRITE(6,40) IT, (X(IJ), Y(IJ), Z(IJ), IJ = II, IF)
   SPLICE
90
91.
92.
                             170 CONTINUE
RETURN
END
  SPLICO
SPLICO
SPLICO
```

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# SUBRØUT I NE TØPM

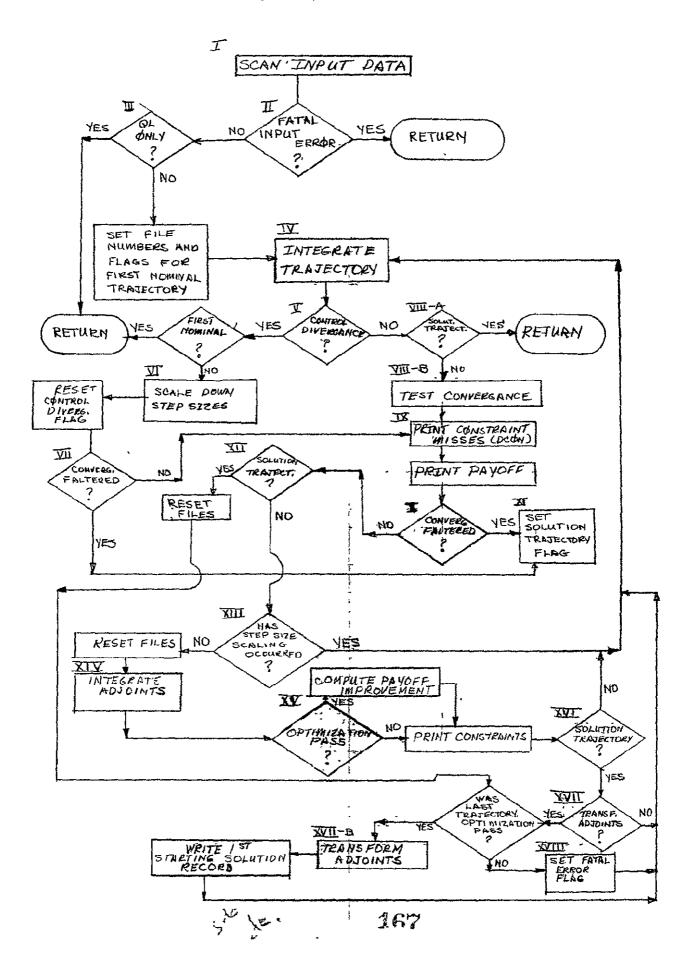
#### TOPM

## Purpose

TOPM is the Steepest Descent module main executive program.

## Description

The reader is referred to Section 2.0 of Volume II for a chart of the overlay structure particularly under this routine (TOPM). The chart shows the names of the routines that are called on UNIVAC equipment instead of the overlay numbers used on CDC equipment. A further description of the iteration procedure generated by TOPM is contained in Section 15.3 of Volume I.



| FURIKAN | MATH   | CODE | DESCRIPTION                                                                                           | STORA     |      |                                                                      |                            | USAGE                                                    |
|---------|--------|------|-------------------------------------------------------------------------------------------------------|-----------|------|----------------------------------------------------------------------|----------------------------|----------------------------------------------------------|
| SYMBOL  | SYMBOL | CODE | DESCUILIION                                                                                           | HLOCK     | LOC  | ५०७४ ।                                                               | 1000                       | VAR                                                      |
| BCON    |        | I Ve | ctor of constraint misses on trial trajectory                                                         | /GENF /(  | 199) | CON3<br>TEST<br>TOPM                                                 | 0<br>1<br>1                | BCON<br>BCON<br>BCON                                     |
| DCON    | ďΨį    |      | ked for correction in constraint misses and<br>yoff vector                                            | /GENF /(  | 289) | CON3<br>MTX3A<br>PAYO2<br>TEST<br>TOPM<br>TRTOSZ                     | 0<br>I<br>M<br>M           | DCON<br>DCON<br>DCON<br>DCON<br>DCON<br>DCON<br>DCON     |
| DELP    |        | D In | put or preset nominal parameter adjustment size                                                       | /PARAM /( | 357) | SDINP<br>TOPM                                                        | 0<br>D                     | DELP<br>DELP                                             |
| DIP1    |        | I Ph | ase initial times for nominal trajectory [sd]                                                         | /GENF /(  | 453) | GETIT<br>SDINP<br>TEST<br>TOPM                                       | I<br>M<br>O<br>I           | OIP1<br>DIP1<br>DIP1<br>DIP1                             |
| 0151    |        | I Ar | c initial times for nominal trajectory [sd]                                                           | /GENF /(  | 473) | GETIT<br>SDINP<br>TEST<br>TOPM<br>TRAN3                              | I<br>M<br>D<br>I<br>I      | DIS1<br>DIS1<br>DIS1<br>DIS1<br>DIS1                     |
| DPAR    | δр     | D Ad | justable parameter corrections                                                                        | /PARAM /( | 264) | ABJUST<br>MTX3A<br>TOPM                                              | I<br>M<br>D                | DPAR<br>DPAR<br>DPAR                                     |
| 10      |        | re:  | four word array containing the basic deck,<br>ference run, case and part case numbers in that<br>der. | /GLOBAL/( | 21)  | BLICO<br>FRENCH<br>GEINP<br>PADS1<br>PRINT<br>SOINP<br>TOPM<br>VEHOF | I<br>I<br>D<br>I<br>I<br>I | ID<br>ID<br>ID<br>ID<br>ID<br>ID                         |
| IDPAY   | d∳     | D In | itial payoff smprovement                                                                              | /STS /(   | 1)   | PAYO2<br>SOINP<br>SOINP<br>SOINP<br>TEST<br>TOPM                     | I<br>1<br>0<br>1<br>I<br>D | DPAY<br>DPAY<br>IST<br>ST<br>DPAY<br>IDPAY               |
| IFAR    |        | M Fi | ie where nominal trajectory data is read from.                                                        | /XCODES/( | 139) | AGETB3<br>AST3<br>TOPM                                               | I<br>I<br>M                | IFAR<br>IFAR<br>IFAR                                     |
| IFATAL  |        | M Fa | tal error flag.                                                                                       | /GLOBAL/( | 17)  | BLICO<br>GEINP<br>PADSI<br>SDINP<br>SPLICO<br>STPIT<br>TOPM          | M<br>0<br>1<br>m<br>0<br>M | IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL |
| IFAW    |        | A Lo | gical file to write current trial trajectory data                                                     | /xcodes/( | 138) | AST3<br>TOPM                                                         | I<br>M                     | IFAW<br>Ifaw                                             |
| IFB     |        | 0 Fi | le where adjoint solution is stored                                                                   | /xcooes/( | 140) | BGET3<br>BST03<br>TOPM                                               | I<br>I<br>0                | IFB<br>IFB<br>IFB                                        |
| IFOB    |        | 0 Fo | rmard or adjoint integration flag<br>= 1 means formard<br>= 2 means adjoint                           | /xcodes/( | 178) | ACCEL<br>BEROCO<br>BLYNE<br>EQUA3<br>IMPUL<br>SPLYNE<br>TOPM         | I<br>I<br>I                | IFOB<br>IFOB<br>IFOB<br>IFOB<br>IFOB<br>IFOB             |
| 1110    |        | D Co | nstraint option code (internal)                                                                       | /XCODES/( | 1)   | AOICB3<br>ADIC3A<br>AOID3A<br>CON3<br>SOINP<br>STAU<br>TOPM          | I                          | 1TQ<br>1TQ<br>1TQ<br>1TQ<br>1TQ<br>1TQ<br>1TQ            |

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| DHIHAN<br>Symbol | MATH<br>Symbol | CODE        | DESCRIPTION                                                                                                            | STORA"<br>BLUCK | SE<br>LOC | SUBROUTIN<br>SUBR COD                                                                       |                                                                       |
|------------------|----------------|-------------|------------------------------------------------------------------------------------------------------------------------|-----------------|-----------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
|                  | ····.          | <del></del> |                                                                                                                        | <del></del>     |           | ····                                                                                        |                                                                       |
| 1 O M G          | $\Omega_{J}$   | D           | Array of arc cut off values [sd]                                                                                       | /GENF /(        | 1)        | ADJUST M FNTG I PRMSET M PROPB I SDINP M STP3 I TOPM D                                      | OMG<br>OMG<br>OMG<br>OMG<br>OMG<br>IOMG                               |
| I PO I NT        |                | B           | Code for each adjustable parameter in steepest descent.                                                                | /PARAM /(       | 1)        | ADJUST I<br>PRMSET I<br>SDINP O<br>STAU I<br>TOPM D                                         | IPOINT<br>IPOINT<br>IPOINT<br>IPOINT<br>IPOINT                        |
| IPRINT           |                | 0           | Print page counter initialization flag                                                                                 | /XCODE\$/(      | 168)      | OUT M<br>TEST I<br>TOPM D                                                                   | IPRINT<br>IPRINT<br>IPRINT                                            |
| ISTART           |                | M           | Initialization and divergance flag                                                                                     | /XCODES/(       | 147)      | AST3 0<br>BLGCON 0<br>BLYNE 0<br>FNTG I<br>MODELA 0<br>PROPIN 0<br>PROPIN 0<br>TEST M       | ISTART |
| I T CT           |                | M           | Iteration counter                                                                                                      | /XCODES/(       | 148)      | BNTG I<br>OUT I<br>TEST M<br>TOPM M                                                         | ITCT<br>ITCT<br>ITCT<br>ITCT                                          |
| ITER             |                | M           | Trajectory pass indicator.  ITER = 1, CONSTRAINTS = 2, OPTIMIZATION = 3, SOLUTION                                      | /XCODES/(       | 149)      | AST3 I<br>FNTG I<br>GETIT I<br>MODELA I<br>OUT I<br>PAYO2 M<br>PROPIN I<br>TEST M<br>TOPM M | ITER ITER ITER ITER ITER ITER ITER ITER                               |
| 1 20P            |                | 0           | First optimization pass flag sets de = DPAY Also used to indicate payoff degradation due to restoration of constraints | /XCODES/(       | 136)      | PAYO2 M<br>TEST M<br>TOPM O                                                                 | 120P<br>120P<br>120P                                                  |
| COP              |                | I           | Counts number of times constraint misses are halved down because of divergance problems                                | /XCODES/(       | 154)      | TEST M<br>TOPM I                                                                            | KOP<br>Kop                                                            |
| <b>CWOM</b>      | V              | 0           | Relative velocity (FT/SEC)                                                                                             | /STATE3/(       | 1)        | ACCELS I ACCELS I ACCELS I ACCELS I ACCELS I ACCELS I I I I I I I I I I I I I I I I I I I   | V V V V V V V V V V V V V V V V V V V                                 |

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| LORTRAN | HTAM   | CODE | DESCRIPTION                                                                                                                                                                       | STORA     |      | SUAHOUTINE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                 |                                                                                        |
|---------|--------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------------------------------------------------------------------|
| PALMOF  | SYMBOL |      | DESCRIPTION                                                                                                                                                                       | BLOCK     | FOC  | SUBR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CODE                            | VAR                                                                                    |
| LUM     |        | M    | Program control flag.  LUM = 0 Steepest descent only;  LUM = 1 Steepest descent and adjoint  transformation stored on tape;  LUM = 2 Steepest descent and QL,  LUM = 3 · QL only. | /GLOBAL/( | 6)   | AST3<br>FNTG<br>GEINP<br>PADS1<br>SDINP<br>TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | I<br>I<br>M<br>I                | LUM<br>LUM<br>LUM<br>LUM<br>LUM<br>LUM                                                 |
| MIXA    |        | D    | Maximum number of mords in trajectory data buffer = 990                                                                                                                           | /RETREV/( | 12)  | AGETB3<br>AST3<br>SDINP<br>TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1                               | MIXA<br>MIXA<br>MIXA<br>MIXA                                                           |
| m1 xB   |        | D    | Maximum number of mords in adjoint data buffer = 3000                                                                                                                             | /RETREV/( | 13)  | 8GET3<br>BST03<br>SDINP<br>TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 | MIXB<br>MIXB<br>MIXB<br>MIXB                                                           |
| NBFA    |        | D    | Maximum number of buffers permitted to store forward trajectory data = 20.                                                                                                        | /RETREV/( | 10)  | AST3<br>Topm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1<br>D                          | NBFA<br>NBFA                                                                           |
| NBFB    |        | Đ    | Maximum number of buffers permitted to store adjoint solution data = 60                                                                                                           | /RETREV/( | 11)  | BST03<br>TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | I<br>D                          | NBFB<br>NBFB                                                                           |
| NCA5E   |        | 0    | Case number                                                                                                                                                                       | /xcobes/c | 159) | TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0                               | NCASE                                                                                  |
| NCN     |        | 1    | Number of elements in d¥                                                                                                                                                          | /xcodes/( | 160) | ADEOSA<br>ADICSA<br>ADICSA<br>ADIOSA<br>ADIOSA<br>ASTS<br>BNTG<br>BSTOSA<br>OUT<br>PAYOZ<br>TEST<br>TOPM<br>TRANS<br>TRIOSZ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                 | NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN                     |
| NCNST   | n      | I    | Number of problem constraints                                                                                                                                                     | /XCODES/( | 132) | BGET3<br>BST03<br>CON3<br>PAY02<br>SDINP<br>SUMS<br>TEST<br>TOPM<br>TRAN3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | I<br>I<br>I<br>I<br>I<br>I<br>I | NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST |
| NEQ     |        | I    | Number of integrated states                                                                                                                                                       | /xcodes/( | 162) | ADICBS<br>ADICS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS<br>ADIDS | l<br>I                          |                                                                                        |
| NEQF    |        | Û    | Number of equations to be integrated on forward trajectory                                                                                                                        | /xcodes/( | 185) | REU3<br>RKTA34<br>SDINP<br>STAU<br>TOPM<br>TR'AN3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1                               | NEOF<br>NN<br>NEOF<br>NEOF<br>NEOF                                                     |
| NOP     |        | I    | Counts number of times payoff is scaled down due to divergance problems                                                                                                           | /XCODES/( | 163) | TEST<br>Topm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | m<br>I                          | NOP<br>NOP                                                                             |

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| ORIRAN<br>Symbol | MATH<br>Symbol     | CODE | DESCRIPTION                                                                                                         |          | STORAG<br>Block | E<br>LOC | SUBROUT<br>SUBR C                                                           |                                                      | USAGE<br>VAR                                                        |
|------------------|--------------------|------|---------------------------------------------------------------------------------------------------------------------|----------|-----------------|----------|-----------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------|
| NPA              |                    | 0    | Running count of number of adjustable parame<br>be perturbed on remainder of trajectory                             | eters to | /PARAM /(       | 14)      | MTX3A                                                                       | I NE                                                 |                                                                     |
| NP AR A          |                    | D    | Number of adjustable parameters in trajector problem.                                                               | ·y       | /PARAM /(       | 13)      | ADJUST<br>BNTG<br>FNTG<br>MTX3A<br>PAY02<br>PRMSET<br>SDINP<br>STAU<br>TEST | I NP M NP I NP         | PARA<br>PARA<br>PARA<br>PARA<br>PARA<br>PARA<br>PARA<br>PARA        |
| NP H             |                    | I    | Number of phases in trajectory                                                                                      |          | /XCODES/(       | 164)     | FNTG<br>PRMSET<br>SDINP<br>TEST                                             | O NF<br>I NF<br>M NF<br>I NF                         | PH<br>PH<br>PH<br>PH<br>PH                                          |
| NST              |                    | I    | Number of arcs in trajectory .                                                                                      |          | /xcodes/(       | 166)     | FNTG<br>PROPB<br>SDINP<br>SDINP<br>TEST<br>TOPM                             | I NS<br>O NS<br>I NS<br>I NS<br>I NS<br>I NS<br>I NS | ST<br>ST<br>ST<br>ST<br>ST                                          |
| OMEGA            | ω                  | 0    | Earth rotation rate (F                                                                                              | AAD/SEC) | /STATE3/(       | 719)     | BL7                                                                         | 1 0                                                  | MEGA<br>Mega<br>Mega                                                |
| OME GA2          | ω <sup>2</sup>     | 0    | See symbol                                                                                                          |          | /STATE3/(       | 720)     | BL7<br>BL8                                                                  | 1 Or<br>1 Or                                         | MEGA2<br>MEGA2<br>MEGA2<br>MEGA2                                    |
| OMGZ             | ω                  | I    | Earth rotation rate (f                                                                                              | RAD/SEC) | /GLOBAL/(·      | 3)       | DERSA<br>EQUAS<br>GEINP<br>MODELA<br>MODELB<br>POBC<br>POYSA<br>SDINP       | 70 I<br>70 I<br>70 I<br>70 I<br>70 I<br>70 I<br>70 I | MGZ<br>MEGA<br>MGZ<br>MGZ<br>MGZ<br>MGZ<br>MGZ<br>MGZ<br>MGZ<br>MGZ |
| PARA             | ₽                  | D    | Adjustable parameter nomînal values.                                                                                |          | /PARAM /(       | 252)     | ADJUST<br>PRMSET                                                            | I PA                                                 | ARA<br>ARA<br>ARA                                                   |
| SPARA            | s <sup>¥₁</sup>    | 0    | Matrix of adjustable parameter sensitivities (including all parameters)                                             | ì        | /PARAM /(       | 15)      | ADJUST<br>Paydz<br>Stau                                                     | I 5F<br>M 5F                                         | PARA<br>PARA<br>PARA<br>PARA                                        |
| 5PARB            | s*ı                | D    | Matrix of adjustable parameter sensitivities<br>(Contains only elements corresponding to par<br>yet to be adjusted) |          | /PARAM /(       | 144)     | ADJUST<br>MTX3A                                                             | 0 SF                                                 | PARB<br>Parb<br>Parb                                                |
| SYAR             | y   <sub>t=0</sub> | i    | Array of state values at initial problem to                                                                         | ne [sd]  | /GENF /(        | 79)      |                                                                             | I 51 I 51 M 51 I 51 M 51 M 51 I 51 I 51              | VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR                       |

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- 2

| FORTRAN<br>Symbol | MATH<br>Symbol | COOE DESCRIPTION                                                                           | <u>SIDRASE</u><br>Block loc | SUBACUTINE USAGE<br>SUBA CODE VAR                                                                                           |
|-------------------|----------------|--------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 521 NV            | [\$\$]         | O Parameter sensitivity contribution to A matrix                                           | /PARAM /( 276)              | ADJUST O S2INV<br>MTX3A M S2INV<br>PAYO2 M S2INV<br>TOPM D S2INV                                                            |
| TPH1              |                | I Phase end times for nominal trajectory                                                   | /GENF /( 413)               | BNTG 1 TPH1 GETIT I TPH1 SOINP 0 TPH1 TEST 0 TPH1 TOPM I TPH1                                                               |
| TST1              |                | I Arc end times for nominal trajectory                                                     | /GENF /( 433)               | BNTG I TST1<br>GETIT I TST1<br>PROPIN I TST1<br>SDINP O TST1<br>TEST O TST1<br>TOPM I TST1<br>TRAN3 I TST1<br>TRTDSZ I TST1 |
| WTP               | [7]            | D Adjustable parameter diagonal weighting matrix order according to IPOINT.                | /PARAM /( 132)              | MTX3A I WTP PAY02 I WTP SDINP 0 WTP TOPM D WTP                                                                              |
| WTPD              |                | U Input or preset adjustable parameter meighting<br>factors according to type of parameter | /PARAM /( 123)              | SDINP M WTPD<br>TOPM D WTPD                                                                                                 |

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```
1. C
3. C
4. C
  PROSRAM TOPM
   STEEPEST DESCENT MAIN PROGRAM
  NF/
OMSP(20,2), VARD(9)
ACON(9) , BCDN(9)
, DT , G
, RE , MACH
, PAR , RCR
, TIMEPH , TIMES
, TPH (20) DIS(20)
, TLS1 (20) DIP(20)
, LIFT , DRAG
, FP , FPOLD
, BV , FVAC
, LIFTA , DBR
, BI FT
  COMMON/SENF/
  TOL(9) SVAR(10)
COTI(9,9) DCOM(9)
DPSD Q
PA RO
CSR VMR
TOP TOS
DIP(20) T
GIS1(20) TIME
TAX TRUEN
   , WDC( 20)
, DTP
, QS
, CS
, SUMSQ
, TR( 9)
, W
, OMP
, TBU( 20)
  +0MG(20)
+A(9,9)
+OTS
+R
+ANU
 16.
11.
  *5VSQ
*TST(20)
*TLP1(20)
*TIMPR
 12.
13.
14.
   ,DIP(2G)
,DIS1(2G)
,TAX
,FPD
   TBURN
MACHE
   =AE
   MACHY
  LIFTY
DRAGY
OB
JULFTY
XMCGA
CGE
ZCS
 16.
17.
18.
19.
20.
21.
22.
23.
   #DR
  DRAGE
ISP
ULFTE
XMCGM
OELTAE
  DRAGA
ISPF
ULFTA
CODAE
,SIO
   *LIFTR
   , DBR
ULFT
  XMCGV
CT
SIDAE
GENF /
  XMCSH
CALPHA
XCG
   *XACG
  *CULFT
*COD
COMMON /
  SÉRF /
XJR
, IRATED
   , SAMMAB
   ,XKP
   , SH
   , XKS
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   GENERAL SECULATION OF THE SECURATION OF THE SECULATION OF THE SECU
   *FRATED
*P1
*XK1T
*XK1A
   , XK1
, XK10
, XK17
, XK10
, XK10
, XK10
, FR
   , XK2
, XK2D
, XK2V
, XK2P
, XK2D
, XK2M
   , XK3D
, XK3D
, XK3V
, XK3P
, XK3D
, XK3D
  .PO
  DEDY(3.8)
32.
33.
35.
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37.
38.
  MACH,
   RETREVALUE OF STATE O
  40_
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45.
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51.
   (20),ITI
,NCNST
,IFAM
,ISPH
,IVAR
,K
,NED
,IPRINT
,IBLK2
  INTB
NSB
IFAR
ISST
ISST
NOP
ISTM
ISTOP
  JSID(20,2), JPH (20,2), NSAB , NICNB , IFB , IND , IARC , ISTART , JPS , JS , NADL , NCASE , NPH , N
   *JST (20)
*I20P
*I20P
*I0PEM , IPH
*ITCT , ITER
*KOP , KPST
*NCN , MEQB
*NST , PST
*IPHNB , IBLK1
*IFOB , NB
*NCTIN , NEOF
*COMMON/DATA/
*PI , RAD
*FINN , CAR
COMMON/GLOBAL/
   ,JS
,NCASE
,N
,ISTNB
  , IPHN
, ISTPP
 5555555566666666677777345.
   , L
NPHB
  , ILAB(8), JPRP,
  MPHP
   Jaii,att,apix(20),JP1
  RDI '
  ,UAF
,JOP3
  ,SC
,JOP2
   ,TMPF
,J0F4
   SLOBAL
SLOBAL
SLOBAL
   ,LUM
,IO(4)
   , YMURF
   NEARC
   GLOBAL
GLOBAL
RETAP
ORBIT
  IPFLG2, IPFLG3, IPFLG4, INEQFL(20)
  P,
APOGEE,
ENERGY,
   XMUI.
   11880
11880
11880
11880
11880
  SMIMAJ,
  DVIDAU.
   D610V.
  OSIDAU,
OSIDAU,
OPIDAO,
DAIDPS,
  DGIDAO,
DPIDPS,
CALOA,
   HG96
   DP DA
  DABIT
  GECOV ;
  DECDS ,
   DECDH ,
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```
DECDM DECDPS,

DIGM DIGM DIDF

DBEGG DECM DBEDM DBEDM DACOG DACOM 
  CABIT
CABIT
CABIT
CABIT
CABIT
CABIT
CABIT
CABIT
             76.
77.
78.
79.
80.
81.
82.
83.
84.
  DIDG
  DBEDV
OBEDMU,
ONDORD,
DSMOPS
   DAPOM ,
   DEEDH
DANDG
DCXDV
DCXDMU,
DCYDRO,
  DREIT
  ORBIT
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               86.
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   DASDPS,
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   CPSII
COSDNU
  DABIT
DABIT
  ORBIT
ORBIT
STATE30
   ,SVY(16)
,SAVBP(15)
,DCDRO2
   *X($\frac{9}{9}\) YOP(2G_9)\ YOS (2G_9)\ OSSAM \ SINGS \
*SINPSI COSPSI \ SINRHO \ COSRHO \ DCOR \
*SYBV (9)\ CRESA \ OREGA2 \ OREGA2 \
*YDV \ OSG \ SDV \ RDV \ MOV \ POV \
*UDV \ OSG \ SDG \ RDG \ PDG \ PDG \
*UDB \ OSG \ YOR \ SDR \ MOR \ PDG \
*UDB \ OSG \ PDG 
  ,00V
,00G
,0DR
,VOP
,600
  163.
164.
165.
166.
168.
169.
110.
  111.
112.
113.
115.
116.
117.
118.
  TOPM
   PARAM
PARAM
PARAM
  PARAM
PARAM
TOPM
PHISZ
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TOPM
TOPM
PHISZ
PHISZ
PHISZ
TOPM
119.
120.
121.
122.
123.
124.
125.
126.
127.
128. C
129.
131
  TOPM
TOPM
PHISZ
  DATA MIXA, MIXB, NBFB / 990,3000,20,60 /

BIMEMSION KNOW(757)
EQUIVALENCE(KNOW, VAR)
DOTA KNOW / 757+0/
10 CONTINUE
20 CONTINUE
1 SCAN INPUT DATA
CALL DVERLAY(#HSDIN,3,1,0)
11 IF IAPOT ERADES RETURN
1F(IFATAL) 50 TO 130
1II IF OL ONLY RETURN
1F(LUM.EO.3) 50 TO 130
SEI FILE NUMBERS AND FLAG FOR FIRST NUMINAL
1FAM = 39
1FAR = 40
1FB = 41
1START = 1
120P = 0
1TER = 1
120P = 0
1TER = 1
  PHISZ
PHISZ
TOPM
TOPM
COMN
TOPM
COMN
TOPM
  131.
132.
133.
134. C
  135.
136.
137.
   ¢
   130-
       138. C
  COMM
TOPM
COMM
TOPM
TOPM
TOPM
139. C
141.
142.
143.
144.
145.
146.
147.
148.
149.
   139-
   TOPM
TOPM
TOPM
TOPM
TOPM
   IPRIAT =1
  ITCT=1
NCASE= IC(3)
OMEGA=OMGZ
```

20 0CT 72 8.61-96

```
IV INTEGRATE TRAJECTORY
V IF NO CONTROL DIVERSANCE ERROR SO TO VIII
ELSE CHECK IF FIRST NCMINAL SO TO XVIII
ELSE GO TO VI

CALL OVERLAY (SHIFNIG, 3, 2, 6HRECALL)
IF(ISTART.NE.6) SO TO TO
IF(ITCT.LE.1) SO TO 125
VI CALL TEST TO SCALE DOWN STEP SIZE(S)
CALL OVERLAY (SHITEST, 3, 3, 0)
IFRINT =1
VII TEST WHETHER SOLUTION CONVERSANCE HAS FALTERED
IF SO GO TO X1 ELSE RESET FLAG AND GO TO IX
IF(ISTART.EQ.5) GO TO 76
ISTART =2
GO TO 60
VIII NORMAL SOLUTION CONVERSANCE
 151
                                   OMEGAZ=OMSZ+DMGZ
  TOPA
   TOPA
TOPA
COAN
                           36 CONTINUE
1FOB =1
 1523.
15545
1557
1557
1559
1661
1665
1667
1667
1670
1771
                  00000
   COMM
COMM
COMM
COMM
TOPM
TOPM
FHISZ
COMM
TOPM
COMM
COMM
   46
  1125
                  C
                  C
  76-
  TOPM
   TOPM
TOPM
TOPM
COMM
COMM
  60-
                 0000
                                      VIII-A
  IF SOLUTION TRAJECTORY HAS ALREADY BEEN INTERATED RETURN ELSE GO TO VIII-B
 173
  CORN
                           46 CONTINUE
IF(ITER.EQ.3) 80 TO 130
IPRINT=1
TEST CONV
   TOPA
TOPA
TOPA
COAN
TOPA
174.
175.
176.
177.
  130
                          1PRINT=1
VIII-B TEST CONVERGANCE
50 CALL OVERLAY(5HITEST,3,3,0)
                 C
 178.
 179
180.
   TOPM
COMM
COMM
TOPM
TOPM
COMM
TOPM
                           60 CONTINUE
                 C
                                  IX PRINT CONSTRAINT MISSES AND PAYOFF
CALL IPRC 4HOCON, DCON, I, NCM, O)
IF(ITER-EQ.2) CALL IPRC 6HPAYOFF, BCQN(NCN), I, 1, O)
IF(ISTART EQ.1) ISTART=2
X IF NO CONVERGANCE PROBLEM GO TO XII ELSE XI
IF(ISTART.NE.5) GO TO 80
XI SET SOLUTION FLAS GO TO XVII
 181
182.
183
184
185.
186.
                C
  80-
   KMGS
   TOPM
TOPM
TOPM
COMM
COMM
                          70 ITER=3
ISTART=2
60 TO 110
 188.
189.
190.
191.
192.
   116-
   IF SOLUTION FLAS NOT SET SO TO XIII
ELSE REVERSE READ AND MRITE FILES AND GO TO XVII
  XII IF
  193.
                           8G CONTINUE
IF(ITER.NE.3) SO TO 9D
IFR=IFAM
IFAM=IFAM
IFAM=IFA
194.
195.
196.
197.
198
199
200.
201.
202.
203
   TOPM
TOPM
TOPM
TOPM
TOPM
COMN
  96-
                                   60 TO 110
  110-
                 0000
   IF STEP-SIZE SCALING HAS OCCURRED RUM AMOTHER TRIAL TRAJECTORY ( GO TO IV )

ELSE RESET FILE NUMBERS GO TO XIV
  COMM
  COAN
                           90 IF(KOP+NOP.ST.D) 50 TO 30
IFR = IFAR
IFAR= IFAW
204.
205.
206
207.
208.
209.
210.
211.
213.
214
215.
216.
   TOPM
TOPM
TOPM
TOPM
COMN
COMN
COMN
COMN
TOPM
TOPM
TOPM
  36
                 ç
                                   XIV INTEGRATE ADJUINT SOLUTION CALL OVERLAY( SHIBNTG, 3, 4,0)
                      XV IF OPTIMIZATION PASS COMPUTE PAYOFF IMPROVEMENT IF( ITER.ME.2) GO TO 100 CALL OVERLAY (SHIPAYD,3,5,0)

100 CALL IPR( HHDCON, DCDN,I,NCN,0) IF(ITER.ED.3) SO TO 110 XVI IF SOLUTION FLAS SET GO TO XVII ELSE GO TO IV
                 C
  100-
217
218.
219.
   TOPM
TOPM
COMM
  116.
                 ε
 220
   TOPA
   36
221.
                       116 CONTINUE
   TOPA
```

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```
XVII IF NO TRANSFORMATION FLAG SET GO TO .XVII-C IF(LUM EQ.O) GO TO 120 IF(NCM EQ NCMST+1) GO TO 115

XVII-A TRANS.FLAG IS SET, IF LAST TRAJECTORY WAS OPTIMIZATION PASS GO TO XVII-B ELSE ERROR FLAG SET , SO TO XVII-C LUM-O GO TO 120
   COMM
TOPM
PHISZ
COMM
COMM
COMM
FHISZ
PHISZ
PHISZ
222
223.
224.
225.
226.
227
239
230
231
232.
234.
235.
236.
237.
238.
237.
238.
237.
240.
241.
  120
                      115 CONTINUE
C XVII-B
  PHISZ
COMM
COMM
TOPM
TOPM
TOPM
TOPM
TOPM
TOPM
TOPM
  CALCULATE TRANSFORMED ADJOINTS WRITE FIRST STARTING SOLUTION RECORD AND GO TO IV
                             ITER=2 CALLOUANE THRASPORMED BUDDING RECORD AND GO TO I ITER=2 CALL OVERLAY (HITRAN, 3,6,0)
REMIND 11
WRITE(11) SVAR(1), MEQ. MST. (DIS1(1), I=1, MST.), (DIP1(3), J=1, NPH)

"(TST1(11), II=1, MST.), (TPH1(IJ), IJ=1, MPH)

ITER=3
GO TO 30
XVII-C RESET NO. OF EQUATIONS, GO TO IV

120 NEGF = NEG +3
GO TO 30
XVIII FATAL ERROR RETURN

125 IFATAL=-TRUE.
   30-
  242
243.
244
  TOPM
TOPM
COMM
   36-
   245
  PH15Z
                               130 CONTINUE
END
  TOPA
TOPA
   246.
247.
```

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# BLØCK AECØ3

| FORTHAN<br>Symbol | MATH<br>Symbol | DESCRIPTION                                  |       | STORAGE<br>Block ( | .oc | <u> </u>                                                                                                      |                                                                               |
|-------------------|----------------|----------------------------------------------|-------|--------------------|-----|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| APHO              | ∝ o′l d        | Angle of attack from last nominal trajectory | (DEG) | /AEC03 /(          | 1)  | AST3 M<br>FNTG I<br>MIX3A I<br>OUT 1<br>PROPB O<br>PROPIN O                                                   | APHO<br>APHO<br>APHO<br>APHO<br>AEZRO<br>AEZRO                                |
| APHR              | α              | Angle of attack                              | (DEG) | /AEC03 /(          | 2)  | AGETB3 O<br>AST3 M<br>BEROCO I<br>BLGCON O<br>GUI3A M<br>MODELA M<br>MODELA M<br>MODELB I<br>MTX3A D<br>GUT I | APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR                  |
| ALPHA             | α              | Angle of attack                              | (RAD) | /AEC03 /{          | 3)  | BEROCO I<br>BLGCON M<br>BL2 I<br>FNTG O<br>MAMECO I<br>MODELA M<br>MODELB O<br>REU3 O<br>VT I                 | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA |
| VDA               | 0°/0∝          | See symbol                                   |       | /AEC03 /(          | 4)  | ACCEL O<br>ADEQ3A I                                                                                           | VDA<br>VDA                                                                    |
| GDA               | ∂ <b>7/</b> ∂∝ | See symbol                                   |       | /AEC03 /(          | 5 ) | ACCEL O<br>ADEQ3A I                                                                                           | GDA<br>GDA                                                                    |
| PDA               | a∳/a∝          | See symbol                                   |       | /AEÇ03 /(          | 6)  | ACCEL O<br>ADEQ3A I                                                                                           | PDA<br>PDA                                                                    |
| SINA              | sin∝           | See symbol                                   |       | /AEC03 /(          | 7)  | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>FH3 I<br>GUI3A M<br>GUT I<br>VT M                              | SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA                  |
| CƏSA              | cos∝           | See sy≋bol                                   |       | /AEC03 /(          | 8)  | ACCEL I BL4 I BL6 I BL7 I BL8 I FH3 I OUT I VT M                                                              | COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA                  |
| PHI0              | ø old          | Bank angle from last nominal trajectory      |       | /AEC03 /(          | 9)  | AST3 M<br>MTX3A I                                                                                             | 01H9<br>01H9                                                                  |
| PHID              | ø              | Bank angle                                   | (DEG) | /AEC03 /(          | 10) | AGETB3 O<br>AST3 M<br>GUI3A M<br>MODELA M<br>MODELB I<br>MTX3A O<br>DUT I                                     | DIH9<br>DIH9<br>DIH9                                                          |
| PHI               | ¢              | Bank angle                                   | (RAD) | /AEC03 /(          | 11) | GUI3A M<br>MODELA M<br>MODELB M                                                                               | PHIR<br>Phi                                                                   |
| SINPHI            | ន៖⊓∲           | See symbol                                   |       | /AEC03 /(          | 12) | ACCEL I<br>BL4 I<br>MODELA M<br>MODELB M<br>OUT I                                                             |                                                                               |

| UKIRAN<br>Symbol | MATH<br>Symbol                 | DESCRIPTION                                                             | S T O R A<br>B L O C K | LUC | 59487011M                                                                  |                                                             |
|------------------|--------------------------------|-------------------------------------------------------------------------|------------------------|-----|----------------------------------------------------------------------------|-------------------------------------------------------------|
| 371100           | 3171106                        |                                                                         | OCOUN                  |     | 337. (00)                                                                  |                                                             |
| COSPHI           | cos∲                           | See symbol                                                              | /AEC03 /(              | 13) | ACCEL I<br>BLY I<br>GUI3A M<br>MODELA M<br>MODELB M<br>NUT I               | COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI    |
| GDPHI            | a?/a¢                          | See symbol                                                              | \/AEC03 /(             | 14) | ACCEL D<br>ADEQ3A I<br>PDY3A O                                             | GDPH<br>GDPH<br>GDPH                                        |
| POPHI            | a•∕/a¢                         | See symbol                                                              | /AEC03 /{              | 15) | ACCEL O<br>ADED3A I<br>PDY3A O                                             | PDPH<br>PDPH<br>PDPH                                        |
| XLAMA            | Λ <sup>†</sup> iΩ <sub>J</sub> | Impulse response function column vector associated with angle of attack | /AEC03 /(              | 16) | ADEQ3A M<br>ADIC3A D<br>AST3 D<br>BGET3 D<br>BST03 M<br>MTX3A I<br>TRAN3 M | XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA |
| XLAMP            | $V_{\hat{A}^1 \mathcal{O}} 1$  | Impulse response function column vector associated with bank angle      | /AEC03 /(              | 25) | ADED3A M<br>ADI3A D<br>AST3 D<br>BGET3 D<br>BST03 M<br>MTX3A I<br>TRAN3 M  | XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP |
| CB0              | $c^{\mathbf{o}_{\mathbf{o}}}$  | Drag coefficient at ∝ = 0                                               | /AEC03 /(              | 34) | BEROCO I<br>EQUAS I                                                        | CD0                                                         |
| CDOM             | ac <sub>o</sub> /am            | See symbol                                                              | /AEC03 /(              | 35) | BEROCO I<br>EQUAS I                                                        | CDOM                                                        |
| CLO              | c <sup>ro</sup>                | Lift coefficient at $\alpha = 0$                                        | /AEC03 /(              | 36) | BERDCO I<br>EQUAS I                                                        | CLO<br>CLO                                                  |
| FK               | k                              | Induced drag coefficient                                                | /AEC03 /(              | 37) | BEROCO I<br>EQUAS I                                                        | FK<br>FK                                                    |
| XCGM             | ∂X <sub>CG</sub> /∂m           | See symbol                                                              | /AEC03 /(              | 38) | EL2 I<br>EQUAS D<br>VT I                                                   | XCGM<br>XCGM<br>XCGM                                        |
| ZCGM             | ∂Z <sub>CG</sub> /∂m           | See symbol                                                              | /AEC03 /(              | 39) | EL2 I<br>EQUAS D<br>VT I                                                   | ZCGM<br>ZCGM<br>ZCGM                                        |
| CLGM             | ac <sub>Lo</sub> /am           | See symbol                                                              | /AEC03 /(              | 46) | BERDCO I<br>EQUAS I                                                        | CLOM                                                        |
| Crt              | C.M                            | Moment coefficient                                                      | /AEC03 /(              | 41) | MAMECO O                                                                   | CM<br>CM                                                    |
| CMA              | € <sub>M∝</sub>                | Moment coefficient slope                                                | /AEC03 /(              | 42) | EQUA3 M<br>MAMECO I<br>VT I                                                | CMA<br>CMA<br>CMA                                           |
| CMAM             | ac <sub>M</sub> a/aw           | See symbol                                                              | /AEC03 /(              | 43) | EQUAS M<br>MAMECO I                                                        | CMAM<br>CMAM                                                |
| CMM              | ac <sub>w</sub> /am            | See sy≡bol                                                              | /AEC03 /(              | 44) | MAMECO O                                                                   | CMM<br>CMM                                                  |
| CM0              | C <sub>M0</sub>                | Moment coefficient at a = 0                                             | /AEC03 /(              | 45) | EQUAS I<br>MAMECO I                                                        | CMO<br>CMO                                                  |
| CYOM             | ac <sub>Mo</sub> /am           | See symbol                                                              | /AEC03 /(              | 46) | EQUA3 I<br>MAMECO I                                                        | CMOM<br>CMOM                                                |
| FKM              | ak/am                          | See symbol                                                              | /AEC03 /(              | 47) | BERDCO I                                                                   | FKM<br>FKM                                                  |
| CLAM             | 9C <sup>r</sup> /9m            | See symbol                                                              | /AEC03 /(              | 48) | BEROCO I<br>EQUAS M                                                        | CLAM                                                        |
| CL               | C <sub>L</sub>                 | Lift coefficient                                                        | /AEC03 /(              | 49) | BEROCO M<br>OUT I<br>VT I                                                  | CL<br>CL                                                    |

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| FORTRAN<br>Symbol | MATH<br>Symbol      | DESCRIPTION            | <u>SIQRAGE</u><br>Blouk | .oc | <u>5 มุคค ย</u><br>8 8 ย 2 |             |                   |
|-------------------|---------------------|------------------------|-------------------------|-----|----------------------------|-------------|-------------------|
| CLA               | cr*                 | Lift coefficient slope | /AEC03 /(               | 50) | BEROCO<br>EQUA3<br>VT      | M           | CLA<br>CLA<br>CLA |
| CLM               | aC <sub>L</sub> ∕am | See symbol             | /AEC03 /(               | 51) | BEROCO<br>VT               |             | CLM<br>CLM        |
| CO                | CD                  | Drag coefficient       | /AEC03 /(               | 52) | BEROCO<br>OUT<br>VT        | 0<br>I<br>I | CD<br>CD<br>CD    |
| CDA               | ac <sub>D</sub> /a∝ | See symbol             | /AEC03 /(               | 531 | BEROCO<br>VT               | rs<br>I     | CDA<br>CDA        |
| CDM               | ac <sub>D</sub> ∕aw | See symbol             | /AEC03 /(               | 54) | BERDCO<br>VT               | 9           | CDM<br>CDM        |

# BLØCK AIRBRE

| FORTRAN<br>Symbol | MATH<br>Symrol | DESCRIPTION                                |             | STORAGI<br>BLOCK | LOC | <u>: UBRDU</u><br>5 UBR |        | E USAGE<br>E VAR |
|-------------------|----------------|--------------------------------------------|-------------|------------------|-----|-------------------------|--------|------------------|
| TAIRB             |                | Airbresther thrust.                        | (LB5)       | /AIRBRE/(        | 11  | EQUA3<br>FH4            | I      | TAIRB<br>TAIRB   |
| TAIRBV            |                | Partial of airbreather thrust WRT velocity |             | /AIRBRE/C        | 2)  | ACCEL<br>FH4            | I<br>I | TAIRBV<br>Tairbv |
| TAIRBH            |                | Partial of airbreather thrust WRT aititude |             | /AIRBRE/(        | 3)  | ACCEL<br>FH4            | I<br>I | TAIRBH<br>Tairbh |
| SFC               |                | Specific fuel consumption                  | (LBS/LB/HR) | /AIRBRE/C        | 4)  | ACCEL                   | I      | SFC              |
| SFCV              |                | Partial of SFC WRT velocity.               |             | /AIRBRE/(        | 5)  | ACCEL                   | 1      | SFCV             |
| SECH              |                | Partial of SFC WRT altitude.               |             | /AIRBRE/(        | 6)  | ACCEL                   | I      | SECH             |

# BLØCK AXL

| ORTHAN<br>Symbol | MATH<br>Symbol | DESCRIPTION                                                   | <u>5 1</u><br>Bi.0 t | 0843E | . <del>00 -</del> | <u> Suarou</u><br>Subr  |              | E USAG<br>E VAR  |
|------------------|----------------|---------------------------------------------------------------|----------------------|-------|-------------------|-------------------------|--------------|------------------|
| <del></del>      | <del></del>    |                                                               |                      |       |                   |                         |              | <del></del>      |
| VA               | a v            | Acceleration vector element.                                  | /AXL                 | /(    | 1)                | ACCEL<br>DER3A          | m<br>I       | AV<br>AV         |
| AG               | a ?            | Acceleration vector element.                                  | /AXL                 | /(    | 2)                | ACCEL<br>DER3A<br>PDY3A | ri<br>I<br>I | AG<br>AG<br>AG   |
| AP               | a*             | Acceleration vector element.                                  | /AXL                 | 74    | 3)                | ACCEL<br>DER3A<br>PDY3A | m<br>1<br>1  | AP<br>AP<br>AP   |
| AΜ               | a R            | Acceleration vector element.                                  | /AXL                 | /(    | 4)                | ACCEL<br>DER3A          | M<br>I       | MA<br>PIA        |
| AY               |                | Name of acceleration partials matrix.                         | /AXL                 | /(    | 5)                | ACCEL<br>ACCEL<br>PDY3A | M<br>0<br>I  | AVV<br>AY<br>AVV |
| AVV              |                | Element of watrix of acceleration vector part; als WRT state. | /AXL                 | /(    | 5)                |                         | -            | ·                |
| A G V            |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 6)                | ACCEL<br>PDY3A          | 0<br>I       | AGV<br>AGV       |
| AP V             |                | Element of watrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 7)                | ACCEL<br>PDY3A          | 0<br>I       | AP V             |
| AMV              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 8)                | ACCEL<br>PDY3A          | 0<br>I       | VPA<br>VPA       |
| AVG              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 9)                |                         |              |                  |
| AGG              |                | Element of matrix of acceleration vector partials WRT state   | /AXL                 | /(    | 10)               |                         |              |                  |
| AP G             | •              | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 11)               |                         |              |                  |
| AMG              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 12)               |                         |              |                  |
| AVP              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 13)               |                         |              |                  |
| AGP              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 14)               |                         |              |                  |
| APP              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 15)               |                         |              |                  |
| AMP              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 16)               |                         |              |                  |
| AVR              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 17)               | ACCEL<br>PDY3A          | 0<br>I       | RVA              |
| AGR              |                | Element of matrix of acceleration vector partials WRT state   | /AXL                 | /(    | 18)               | ACCEL<br>PDY3A          | 1            | AGR<br>AGR       |
| APR              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 19)               | ACCEL<br>PDY3A          | i<br>I       | APR<br>APR       |
| AMR              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 26)               | ACCEL<br>PDY3A          | 1,0          | RMA<br>RMA       |
| AVO              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 21)               |                         |              |                  |
| AGO              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | '22)              |                         |              |                  |
| APO              |                | Element of matrix of acceleration vector partials WRT state   | /AXL                 | /(    | 23)               |                         |              |                  |
| АМО              |                | Element of matrix of acceleration vector partials WRT state   | /AXL                 | /{    | 24)               |                         |              |                  |
| AVU              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 25)               |                         |              |                  |
| AGU              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 26)               |                         |              |                  |
| APU              |                | Element of matrix of acceleration vector partials WRT state.  | /AXL                 | /(    | 27)               |                         |              |                  |

| SYMBOI<br>SYMBOI | MAIH<br>Symbol | DESCRIPTION                                                  | 51<br>8601 | OHA: | if<br>LOL | <u>5 0840 (</u><br>5 084 |        |            |
|------------------|----------------|--------------------------------------------------------------|------------|------|-----------|--------------------------|--------|------------|
| AMU              |                | Element of matrix of acceleration vector partials WRT state  | /AXL       | /(   | 28)       |                          |        |            |
| AVM              |                | Element of matrix of acceleration vector partials WAT state. | /AXL       | 70   | 29)       | ACCEL<br>PDY3A           | 0      | NVA<br>NVA |
| AGM              |                | Element of matrix of acceleration vector partials WRT state. | /AXL       | 70   | 30)       | ACCEL<br>PDY3A           | 0<br>I | AGM<br>AGM |
| APM              |                | Element of matrix of acceleration vector partials WRT state. | /AXL       | /(   | 31,       | ACCEL<br>PDY3A           | 0<br>I | APM<br>APM |
| AMM              |                | Element of matrix of acceleration vector partials WRT state. | /AXL       | /(   | . 32)     | PDY3A                    | 1      | AMM        |

#### BLØCK DATA

| ONTRAN      | MATH   | DESCRIPTION                                                |       | ORA! |     | รมสหลับ                                                                                                 |                                         |                                                                    |
|-------------|--------|------------------------------------------------------------|-------|------|-----|---------------------------------------------------------------------------------------------------------|-----------------------------------------|--------------------------------------------------------------------|
| SYMBOL      | SYMBOL | DESCUTLITUR                                                | 8100  | ·    | LOC | \$08k                                                                                                   | CODE                                    | VAR                                                                |
| Pl          | π      | Constant 3.141592653                                       | /DATA | 71   | 1)  | OUT<br>PADS1                                                                                            | 1<br>D                                  | PI<br>PI                                                           |
| R AÐ        |        | Radian to angle conversion, 57 29577951                    | /DATA | /(   | 2)  | BEROCO<br>BLGCON<br>ENVPRO<br>EQUISA<br>MODELA<br>MIXSA<br>OUT<br>PADS1<br>SDINP<br>TRIOS2              | 1 I I I I I I I I I I I I I I I I I I I | DEG<br>RADD<br>RADD<br>RADD<br>RADD<br>RADD<br>RADD<br>RADD<br>RAD |
| <b>គ</b> ួរ |        | Angle to radian conversion, .01745329252                   | /DATA | 70   | 3)  | BLICO<br>DERSA<br>FNTG<br>GUISA<br>MODELA<br>MODELA<br>PADSI<br>PROPB<br>PROPI<br>REUS<br>SOINP<br>SOMG | 3 I<br>0<br>I                           | RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI |
| sc          |        | Constant in Sutherlands equation, 198                      | /DATA | /(   | 4)  | PADS1<br>PAT63                                                                                          | D<br>I                                  | SC<br>SC                                                           |
| UMF         |        | Constant in Sutherlands equation,                          | /DATA | /(   | 5)  | PADS1<br>PAT63                                                                                          | 0<br>1                                  | UMF<br>UMUF                                                        |
| TMPF        |        | Constant in Sutherlands equation, 392                      | /DATA | Æ    | 6)  | PADS1<br>PAT63                                                                                          | Đ<br>I                                  | TMPF<br>TF                                                         |
| FTNM        |        | Feet to haut. mi. conversion, 1.645791629x10 <sup>-4</sup> | /DATA | /(   | 7)  | OUT<br>PADS1<br>TRTOS                                                                                   | T<br>D<br>I I                           | FTNM<br>FTNM<br>FTNM                                               |
| CAR         |        | Constant, 1715.4827                                        | /DATA | 76   | 8)  | PADSI                                                                                                   | Ð                                       | CAR                                                                |

# BLØCK GENF

| FORTRAN | MATH            | DESCRIPTION                                                       |        | RAG |      | 5 และลอบ                                                                       | TINE                       | UŞAŞE                                                         |
|---------|-----------------|-------------------------------------------------------------------|--------|-----|------|--------------------------------------------------------------------------------|----------------------------|---------------------------------------------------------------|
| SYMBOL  | SYMBOL          | DC 3CHI1 LION                                                     | BLOCK  |     | FUC  | รบชห                                                                           | 1001                       | RAV                                                           |
| OMG     | $\Omega_{ m J}$ | Array of arc cut off values <sup>e</sup> [sd]                     | /GENF  | /(  | 1)   | ADJUST<br>FNTG<br>PRMSET<br>PROPB<br>SOINP<br>STP3<br>TOPM                     | 1                          | 0 M G<br>0 M G<br>0 M G<br>0 M G<br>0 M G<br>0 M G<br>1 0 M G |
| OMGP    |                 | Array of phase cut off values [sd]                                | /GENF  | /(  | 21)  | ADJUST<br>FNTG<br>PRMSET<br>SDINP                                              | M                          | OMGP<br>OMGP<br>OMGP<br>OMGP                                  |
| VARQ    | (VARQ)          | Desired constraint values Esd)                                    | /GENF  | /(  | 61)  | CON3<br>SDINP<br>TEST                                                          | I<br>M<br>I                | VARQ<br>VARQ<br>VARQ                                          |
| TOL     |                 | Tolerence on constraint pisses [sd]                               | /GENF  | /(  | 70)  | SOINP<br>SUMS<br>TEST                                                          | ri<br>I<br>I               | TOL<br>TOL<br>TOL                                             |
| SVAR    | y   t=0         | Array of state values at initial problem time [sd]                | /GENF  | /(  | 79)  | ADJUST<br>BNTG<br>FNTG<br>PRMSET<br>REU3<br>SDINP<br>TEST<br>TOPM<br>TRTOSZ    | I<br>M<br>I<br>M<br>I      | SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR  |
| MDC     |                 | Array of drop peight per arc[sd] (LBS)                            | /GENF  | /(  | 89)  | BNTG<br>REU3<br>SDINP                                                          | I<br>I<br>M                | MDC<br>MDC<br>MDC                                             |
| Α       | A               | Control integral matrix                                           | /GENF  | /(  | 109) | ADEQSA<br>ADICBS<br>BGETS<br>BNTG<br>BSTDS<br>MTX3A<br>PAYD2<br>SDINP<br>TRANS |                            | A A A A A A A A                                               |
| ACON    |                 | Vector of nominal constraint misses + PAYOFF .<br>IMPROVEMENT     | /GENF  | /(  | 190) | CON3<br>TEST                                                                   | M<br>M                     | ACON<br>ACON                                                  |
| BCON    |                 | Vector of constraint misses on trial trajectory                   | /GENF  | /(  | 199) | CON3<br>TEST<br>TOPM                                                           | O<br>I<br>I                | BCON<br>BCON<br>BCON                                          |
| COTI    |                 | Temp storage for a matrix also called B matrix                    | /GENF  | /(  | 208) | ADICB3<br>MTX3A<br>TRAN3                                                       | e<br>e<br>e                | COTI<br>B<br>COTI                                             |
| DCON    | d∳,             | Asked for correction in constraint misses and payoff<br>vector    | /GENF  | /(  | 289) | CON3<br>MTX3A<br>PAYO2<br>TEST<br>TOPM<br>TRTOSZ                               | 0<br>1<br>M<br>M<br>I<br>I | OCON<br>OCON<br>OCON<br>OCON<br>OCON<br>OCON                  |
| ÐTP     |                 | Altered integration interval requite hit phase cut off [sd] (SEC) | /GENF  | /(  | 298) | FNTG                                                                           | М                          | DTP                                                           |
| DTS     |                 | Altered integration interval requito hit arc cut-off [sd] (SEC)   | /GENF  | /{  | 299) | FNTG                                                                           | M                          | DTS                                                           |
| DT      |                 | Integration interval (SEC)                                        | / GENF | /(  | 300) | BNTG<br>FNTG<br>REU3<br>RKTA3A<br>RKTB3A<br>STP3<br>YREF3                      |                            | OT<br>OT<br>DT<br>P<br>P<br>DT                                |

| ORTRAN<br>Symbol | MATH<br>Symbol    | DESCRIPTION                                                             | V                  | <u> </u> | ORA( | LOC  | <u>\$ UBROU</u><br>\$ UBH                                                          |                                         | SEGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG         |
|------------------|-------------------|-------------------------------------------------------------------------|--------------------|----------|------|------|------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------|
| G                | g                 | Gravitational attraction                                                | (FT/SEC**2)        | /GENF    | K    | 301) | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELB<br>PDY3A<br>SDER3<br>SDER3           | 1 1 1 1 1 1 1 1 1 1 1 1 1               | 88888888                                       |
| DPSQ             | (dP) <sup>2</sup> | Metric of control and parameter chang                                   | es [sd]            | /GENF    | /(   | 302) | PAYO2<br>TEST<br>TRTOSZ                                                            | M<br>M<br>I                             | P\$156                                         |
| 0                | ą                 | Dynamic pressure                                                        | (PSF)              | /GENF    | /(   | 303) | ENVPRM<br>EQUA3<br>OUT<br>PDBC<br>VT                                               | I<br>M<br>I<br>I                        | 0<br>0<br>0                                    |
| a s              |                   | Product of dynamic pressure and aero.                                   | Ref. Area<br>(LBS) | /GENF    | /(   | 304) | EQUA3<br>VT                                                                        | 0<br>I                                  |                                                |
| R                | Ř                 | Radial distance from earth center to                                    |                    | /GENF    | /(   | 305) | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>PDBC<br>PDY3A<br>TRTOSZ | IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII | R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R |
| RE               | Rey               | Unit reynoids number                                                    | (1/FT)             | /GENF    | /(   | 306) | OUT<br>PDBC                                                                        | M                                       |                                                |
| HJAM             | M                 | Mach number                                                             |                    | /GENF    | /(   | 307) | BEROCO<br>ENVPRE<br>EQUAS<br>OUT                                                   |                                         | MACH<br>MACH                                   |
| PA               | Pa                | Ataospheric pressure                                                    | (PSF)              | /GENF    | /(   | 308) | EQUAS<br>FH2<br>IMPUL<br>DUT<br>PDBC<br>SDERS                                      | MIII                                    | DZM<br>PA<br>PA<br>PA<br>PA                    |
| RO               | P <sub>a</sub>    | Atmospheric density                                                     | (SLU6S/FT**3)      | /GENF    | /(   | 309) |                                                                                    | I<br>I<br>I<br>I<br>I<br>I              | RO<br>RO<br>RO<br>RO<br>RO                     |
| cs               | a                 | Speed of sound                                                          | (FT/SEC)           | /GENF    | /(   | 310) | EQUA3<br>OUT                                                                       | A                                       |                                                |
| VNU              | μ,                | Atmospheric viscosity [dynamic]                                         | (SLUGS/FT/SEC)     | /GENF    | /(   | 311) |                                                                                    | l<br>I                                  | VNU                                            |
| PAR              |                   | Deriv. Of press. Wrt alt.                                               |                    | /GENF    | 75   | 312) | ACCEL<br>FH2                                                                       | I<br>I                                  | PAR                                            |
| ROR              |                   | Deriv. Of density mrt alt.                                              |                    | /GENF    | /(   | 313) |                                                                                    | I<br>I<br>I<br>I                        |                                                |
| CSR              |                   | Deriv Of speed of sound art alt.                                        |                    | /GENF    | 70   |      | EQUAS                                                                              | I                                       | CSR                                            |
| VNR              |                   | Deriv.of viscosity ort alt.                                             |                    | / GENF   | /(   |      | POBC                                                                               | I                                       | VNR                                            |
| SUMSQ            |                   | Sum of squares of constraint misses (<br>tolerances on trial trajectory |                    | /GENF    | /(   |      | TEST                                                                               | Ħ                                       | SUMS                                           |
| SVSO             |                   | Same as sumsy but saved for nominal t                                   | rajectory [sd]     | /GENF    | /(   | 317) | TEST                                                                               | 14                                      | SVS                                            |

| PARTRAN<br>108my2 | MATH<br>Symbol | DESCRIPTION                                                            |              | ST(    | HAG        | €<br>LOC | <u>5 UBRO (</u><br>5 UBB                                                                                                     |                                                          | USAGE<br>VAR                                                 |
|-------------------|----------------|------------------------------------------------------------------------|--------------|--------|------------|----------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------|
| TIMEPH            | т <sub>р</sub> | Phase time (SE                                                         | EC) /        | GENF   | /(         | 318)     | EQUA3<br>FNTG<br>GETIT<br>GUI3A<br>OUT                                                                                       | 0<br>M<br>I<br>I<br>1                                    | TIMEPH<br>TIMEPH<br>TIMEPH<br>TIMEPH<br>TIMEPH               |
| TIMES             | r              | Arc time (SE                                                           | EC) /        | GENF   | /(         | 319)     | AST3<br>EQUA3<br>FNTG<br>GETIT<br>DUT                                                                                        | I<br>0<br>M<br>I<br>I                                    | TIMES<br>TIMES<br>TIMES<br>TIMES<br>TIMES                    |
| TOP               |                | Elasped time at phase initiation                                       | ,            | GENF   | 70         | 320)     | BNTG<br>EQUAS<br>ENTG                                                                                                        | M<br>I<br>M                                              | TOP<br>TOP<br>TOP                                            |
| T05               |                | Elasped time at arc institution                                        | ,            | GENF   | /(         | 321)     | BNTG<br>EQUA3<br>FNTG                                                                                                        | ra<br>I<br>M                                             | TOS<br>TOS<br>TOS                                            |
| TR                |                | Vector modifier of impulse response function in<br>control calculation | ,            | GENF   | 10         | 322)     | MTX3A<br>TRAN3                                                                                                               | M                                                        | TR<br>TR                                                     |
| TST               |                | Array of arc end times on trial trajectory Esdl                        | ,            | 'GENF  | /(         | 331)     | ADICBS<br>BNTG<br>FNTG<br>TEST                                                                                               | I I 0 0 1 I I                                            | TST<br>TST<br>TST<br>TST                                     |
| TPH               |                | Array of phase end times on trial trajectory [sd]                      | ,            | GENF   | 7(         | 351)     | FNT6<br>TEST                                                                                                                 | 0<br>I                                                   | TPH<br>TPH                                                   |
| DIS               |                | Array of arc end integration intervals for trial trajectory            | ,            | GENF   | Æ          | 371)     | BNTG<br>FNTG                                                                                                                 | I<br>O                                                   | DIS<br>DIS                                                   |
| BIP               |                | Array of phase end integration intervals for trial trajectory          | ,            | GENF   | 70         | 391)     | BNTG<br>FNTG                                                                                                                 | I                                                        | DIP<br>DIP                                                   |
| T                 | Ť              | Thrust (LE                                                             | 85) /        | 'GENF  | <b>/</b> ( | 411)     | ACCEL<br>8L6COF<br>8L6<br>8L7<br>8L7<br>8L2<br>EQUA3<br>FH1<br>FH2<br>FM3<br>FM9<br>PROPB<br>PROPB<br>PROPB<br>REU3<br>SOER3 | I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I | T                                                            |
| ¥                 | Ы              | Weîght (Lf                                                             | B5) <i>i</i> | / GENF | /(         | 412)     | BL5<br>ENVPRO<br>EQUAS<br>FH3<br>OUT<br>POBC<br>REUS<br>TRTOS                                                                | ra<br>I<br>I<br>I<br>I                                   | 년<br>년<br>년<br>년                                             |
| TLP1              |                | Phase end times for nominal trajectory                                 | •            | / GENF | /(         | 413)     | BNTG<br>GETIT<br>SDINP<br>TEST<br>TOPM                                                                                       | 1<br>0<br>1                                              | TPH1<br>TPH1<br>TPH1<br>TPH1<br>TPH1                         |
| TLS1              |                | Arc end times for nowinal trajectory                                   | •            | / ĠENF | /(         | 433)     | BNTG<br>GETIT<br>PROPI!<br>SDINP<br>TEST<br>TOPM<br>TRANS<br>TRIOS                                                           | 0<br>0<br>I<br>I                                         | TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1 |

| URTHAN | MAIH           | DESCRIPTION                                                         |        | STORA  |      |                                                                                     |                                 | USAGE                                                        |
|--------|----------------|---------------------------------------------------------------------|--------|--------|------|-------------------------------------------------------------------------------------|---------------------------------|--------------------------------------------------------------|
| ZAMBOF | SYMBOL         | DESCRIPTION                                                         | В      | LOCK   | LOL  | SUBR                                                                                | COO                             | VAR                                                          |
| OIPl   |                | Phase initial times for nominal trajectory Esdl                     | / G t  | ENF /( | 453) | GETIT<br>SOINP<br>TEST<br>TOPM                                                      | I<br>M<br>O<br>I                | 01P1<br>01P1<br>01P1<br>01P1                                 |
| 0151   | ,              | Arc initial times for nominal trajectory [ad]                       | / G E  | NF /(  | 473) | GETIT<br>SDINP<br>TEST<br>TOPM<br>TRAN3                                             | I<br>A<br>G<br>I<br>I           | 0151<br>0151<br>0151<br>0151<br>0151                         |
| TIME   | t              | Time (elapsed)                                                      | / G E  | ENF /( | 493) | ADICB: AST3 BNTG COH3 COH3 FNTG EQUAS FNTG PROPE PROPI REU3 RKTAS RKTAS RKTAS RKTAS |                                 | TIME TIME TIME TIME TIME TIME TIME TIME                      |
| OMP    |                | Phase cut-off value                                                 | / GE   | ENF /C | 494) | ADJUS<br>FNTG<br>STP3                                                               | T 0<br>A<br>I                   | 0 MP<br>0 MP<br>0 MP                                         |
| TIMPR  |                | Trajectory print time                                               | / G 6  | ENF /( | 495) | BNTG<br>FNTG<br>RKTA31<br>RKTB3                                                     |                                 | TIMPR<br>TIMPR<br>TP<br>TP                                   |
| LIFT   | L              | Aerodynawic lift (LE                                                | 5) /GI | ENF /( | 496) | ACCEL<br>BL4<br>BL5<br>BL6<br>ENVPRI<br>FH3<br>OUT<br>PROPB<br>PROPI<br>VI          | I<br>1<br>0                     | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT |
| DRAG   | O              | Aerodynamic drag (LE                                                | 5) /G  | ENF /( | 497) | ACCEL<br>BL5<br>BL7<br>BL8<br>ENVPR<br>FH3<br>OUT<br>PROPE<br>SDER3<br>VT           | 1<br>1<br>1<br>1<br>1<br>1<br>1 | DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG |
| TBURN  | † <sub>b</sub> | Rocket burn initiation time on forward trajectoryise                | ) /GI  | ENF /( | 499) | EQUAS<br>MODEL<br>PROPB<br>PROPI                                                    | A 1<br>0                        | TBURN<br>TBURN<br>TBURN<br>TBURN                             |
| TBU    |                | Saved rocket burn initiation times used during adjointegration (sd) | nt /GI | ENF /( | 500) |                                                                                     | 1                               | TBU<br>TBU                                                   |
| ΑĘ     | Aexit          | Total nozzie exit area                                              | / G1   | ENF /( | 520) |                                                                                     | 1<br>1<br>0<br>N 0              | AE<br>AE<br>AE<br>AE<br>AE<br>AE                             |

| ORTRAN<br>Symbol | MATH<br>Symbol | DESCRIPTION                                                    | BLOCK | ORA | LOC . | SUBROU<br>Subr                                             |                            | <u>e usage</u><br>E var                            |
|------------------|----------------|----------------------------------------------------------------|-------|-----|-------|------------------------------------------------------------|----------------------------|----------------------------------------------------|
| 31100L           | JIMOUL         |                                                                | 0.00  |     |       | J V D N                                                    |                            | - FHI                                              |
| FP               |                | Current value of cut-off function - non-linear only            | /GENF | 70  | 521)  | OTF3<br>STP3<br>TOL3<br>YREF3                              | I<br>I<br>I                | FP<br>FP<br>FP                                     |
| FPOLO            |                | Value of non-linear cut-off function at prior compute interval | /GENF | /(  | 522)  | DTF3<br>STP3<br>TOL3<br>YREF3                              | I<br>0<br>0<br>I           | FPOLD<br>FPOLD<br>FPOLD                            |
| FPO              |                | Rate of change of non-linear cut-off function                  | /GENF | /(  | 523)  | CON3<br>DTF3<br>STP3<br>YREF3                              | I<br>I<br>I                | FPD<br>FPD<br>FPD<br>FPD                           |
| MACHR            |                | Partial of mach number mrt altitude                            | /GENF | /(  | 524)  | EQUA3<br>PROPB<br>PROPIN<br>VT                             | 0<br>0<br>0<br>1           | MACHR<br>ZERO<br>ZERO<br>MACHR                     |
| MACHV            |                | Partial of mach number mrt velocity                            | /GENF | /(  | 525)  | EQUA3                                                      | 0                          | MACHV                                              |
| OR               |                | Partial of dynamic pressure wrt eltitude                       | /GENF | /(  | 526)  | EDUA3                                                      | M<br>I                     | QR<br>QR                                           |
| ۵v               |                | Partial of dynamic pressure wrt velocity                       | /GENF | H   | 527)  | EQUAS<br>TEST<br>VT                                        | M<br>M<br>I                | 0 A<br>5 A<br>5 A                                  |
| FVAC             |                | Total vacuum thrust Erocket) (LB5)                             | /GENF | 70  | 528)  | ACCEL<br>EQUAS<br>FH2<br>IMPUL<br>PROPB<br>PROPIN<br>SDERS | I<br>M<br>M<br>M<br>M      | FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC       |
| LIFTV            |                | Partial of lift wrt velocity                                   | /GENF | /(  | 529)  | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                    | I<br>I<br>I<br>I<br>I      | LIFTY<br>LIFTY<br>LIFTY<br>LIFTY<br>LIFTY          |
| LIFTR            |                | Partial of lift ert altitude                                   | /GENF | /(  | 530)  | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                    | I<br>I<br>I<br>I<br>O      | LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR |
| LIFTA            |                | Partial of lift wrt angle-of-attack                            | /GENF |     | 531)  | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                    | 1<br>1<br>1<br>1<br>1<br>0 | LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA |
| DRAGV            |                | Partial of drag ort velocity                                   | /GENF | 70  | 532)  | ACCEL<br>8L5<br>BL7<br>BU8<br>FH3<br>VT                    | 1<br>1<br>1<br>1           | DRAGV<br>DRAGV<br>DRAGV<br>DRAGV<br>DRAGV          |
| DAAGR            |                | Partial drag ort altitude                                      | /GENF | /(  | 533)  | ACCEL<br>BL5<br>BL7<br>BLB<br>FH3<br>VT                    | I<br>I<br>I<br>I           | DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR |
| DRAGA            |                | Partial of drag wrt angle of attack                            | /GENF | /(  | 534)  | ACCEL<br>BL5<br>BL7<br>BL8<br>FH3<br>VT                    | I<br>I<br>I<br>I           | DRAGA<br>DRAGA<br>DRAGA<br>DRAGA<br>DRAGA          |

| FOHTRAN<br>Symbol | MATH<br>Symbol         | DESCRIPTION                                |             | BLOCK  | ORA( | LOC         | <u> </u>                                                                |                       | E USAGE<br>VAR                                              |
|-------------------|------------------------|--------------------------------------------|-------------|--------|------|-------------|-------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------|
|                   |                        | <del></del>                                | <del></del> |        |      | <del></del> | ·                                                                       |                       | <del> </del>                                                |
| LIFTM             |                        | Perties of LIFT ort mass                   |             | /GENF  | /(   | 535)        | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                                 | I<br>I<br>I<br>I<br>O | LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM          |
| DBR .             |                        | Partial of base drag #rt aititude          |             | / GENF | /(   | 536)        | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>VT                 |                       | OBR<br>OBR<br>OBR<br>OBR<br>OBR<br>OBR<br>OBR               |
| OB                | D P                    | Base drag                                  | (LBS)       | /GENF  | 10   | 537)        | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>OUT<br>SDER3<br>VT |                       | 08<br>08<br>08<br>08<br>08<br>08<br>08<br>08                |
| ISP               | I <sub>sp</sub>        | Net vacuum specific impulse                |             | /GENF  | /(   | 538)        | ACCEL<br>IMPUL                                                          | I                     | ISP<br>ISP                                                  |
| 1SPF              | ·                      | Partial of ISP ort vacuum thrust           |             | /GENF  | /(   | 539)        | ACCEL<br>IMPUL                                                          | I                     | ISPF<br>ISPF                                                |
| ULFT              | L <sub>U</sub>         | Untrimmed aero.lift                        |             | /GENF  | ¥C   | 540)        | BL3<br>MODELA<br>VT                                                     | I                     | ULFT<br>ULFT<br>ULFT                                        |
| ULFTY             |                        | Partial of ULFT mrt velocity               |             | /GENF  | /(   | 541)        | BL3<br>VT                                                               | 1                     | ULFTV<br>ULFTV                                              |
| ULFTR             |                        | Partial of ULFT ort altitude               |             | /GENF  | /(   | 542)        | BL3<br>VT                                                               | 1                     | ULFTR<br>ULFTR                                              |
| ULFTA             |                        | Partial of ULFT wrt angle of attack        |             | /GENF  | ņ    | 543)        | BL3<br>VT                                                               | I                     | ULFTA<br>ULFTA                                              |
| XMCG              | M <sub>CG</sub>        | Aerodynamic moment about center of gravity | (FT-LBS)    | /GENF  | /(   | 544)        |                                                                         | I                     | XMCG<br>XMCG<br>XMCG                                        |
| XWCGA             |                        | Partial of XMCG ort velocity               |             | /GENF  | /(   | 545)        | EL2<br>VT                                                               | I                     | >4CGA                                                       |
| XMCGR             |                        | Partial of XMCG urt altitude               |             | /GENF  | /(   | 546)        | EL2<br>VT                                                               | I                     | XMCGR<br>XMCGR                                              |
| XMCGA             |                        | Partial of XMCG wrt angle of attack        |             | /GENF  | /(   | 547)        | EL2<br>VT                                                               | I<br>M                | XMCGA<br>XMCGA                                              |
| XMCGM             |                        | Partial of XMCG ort wass                   |             | /GENF  | 70   | 548)        |                                                                         | 1                     | XMCGM<br>XMCGM                                              |
| CODAE             | cσs(α-δ <sub>Ε</sub> ) | See symbol                                 |             | /GENF  | 70   | 549)        | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>SDER3<br>VT                 | I I I I I I I O       | CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE |
| CULFT             |                        | Constant value of ULFT                     | (LBS)       | /GENF  | 70   | 550)        |                                                                         | I<br>O                | CULFT<br>CULFT                                              |
| CT                |                        | Constant value of vacuum thrust            | (LBS)       | /GENF  | /(   | 551)        |                                                                         | 1                     | CT                                                          |
| CALPHA            |                        | Constant value of angle-of-attack          | (RAD)       | /GENF  | /(   | 552)        | BL2<br>MODELA<br>MODELB                                                 |                       | CALPH:<br>CALPH:<br>CALPH:                                  |

| ORTRAN<br>Symbol | MATH<br>Symbol         | DESCRIPTION                                                             |         | BLOCK  | <u> </u> | LOC  | \$ UBR (                                       |                            | USAGE<br>VAR                                                |
|------------------|------------------------|-------------------------------------------------------------------------|---------|--------|----------|------|------------------------------------------------|----------------------------|-------------------------------------------------------------|
|                  | ·····                  |                                                                         |         |        |          |      |                                                |                            |                                                             |
| CDE              |                        | Constant value of engine deflection                                     | (RAD)   | /GENF  | /(       | 553) |                                                | 0                          | CDE<br>CDE                                                  |
| DELTAE           | 6€                     | Engine gimba'l deflection angle                                         | (RAB)   | /GENF  | 70       | 554) | BLGCON<br>EL1<br>OUT<br>REU3<br>VT             | M<br>1<br>0<br>I           | DELTAE<br>DELTAE<br>DELTAE<br>DELTAE<br>DELTAE              |
| SID              | sin(8 <sub>E</sub> )   | See symbol                                                              |         | /GENF  | /(       | 5551 | EL2<br>OUT<br>VT                               | 1<br>I                     | 510<br>510<br>510                                           |
| COD              | cos(8 <sub>E</sub> )   | See symbol                                                              |         | /GENF  | /(       | 556) | EL2<br>OUT<br>VT                               | I<br>I<br>M                | COD<br>COD<br>COD                                           |
| SIDAE            | sin(α-6 <sub>E</sub> ) | See symbol                                                              |         | /GENF  | /(       | 557) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>VT | I<br>I<br>I<br>I<br>I<br>I | SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE |
| XCB              | Х <sub>С</sub>         | Center of gravity body x station                                        | (FT)    | /GENF  | 70       | 558) | EL2<br>EQUA3<br>VT                             | 1<br>1<br>1                | XCG<br>XCG                                                  |
| ZCG              | Z <sub>CG</sub>        | Center of gravity body z station                                        | (FT)    | /GENF  | /(       | 559) |                                                | I<br>I<br>I                | ZCG<br>ZCG<br>ZCG                                           |
| XJ               | j                      | Control blend factor                                                    |         | /GENF  | /(       | 560) | EL2<br>EQUA3<br>OUT<br>VT                      | I<br>I<br>I                | XI<br>XI<br>XI<br>XI                                        |
| ALX              |                        | Partial of blend factor wrt velocity                                    |         | /GENF  | 16       | 561) |                                                | 1<br>0<br>1                | X1A<br>X1A<br>X1A                                           |
| ALX              |                        | Partial of blend factor wrt altitude                                    |         | /GENF  | 70       | 562) | EL2<br>EQUA3<br>VT                             | I<br>0<br>I                | XTB<br>XTB<br>XTB                                           |
| GH               |                        | Partial of gravity wrt altitude                                         |         | /GENF  | 70       | 563) | BL7<br>BL8<br>EQUA3<br>PDY3A                   | I<br>I<br>0<br>I           | SH<br>GH<br>DGDH                                            |
| GAMMAD           |                        | Pitch rate                                                              | (RAD)   | / GENF | /(       | 564) | BL4<br>PROPB<br>PROPIN                         | 1<br>0<br>0                | GAMMAD<br>GAMMAD<br>GAMMAD                                  |
| xkg              | k,                     | Algebraic equation used in vertical rise and pi                         | tchover | /GENF  | /(       | 565) | BL4<br>MODELA<br>MODELB                        |                            | XKGAM<br>XKGAM                                              |
| XKP              | k <sub>¥</sub>         | Algebraic equation used in vertical rise and pi                         | tchaver | /GENF  | /(       | 566) | BL4<br>MODELA<br>MODELA<br>MODELB<br>MODELB    | Ĭ<br>M                     | XKPS<br>XKPSI<br>XKPS<br>XKPSI                              |
| FRATEB           |                        | Net rated maximum rocket vacuum thrust                                  | (LB5)   | /GENF  | /{       | 567) | IMPUL<br>PROPB<br>PROPIN                       | Ō                          | FRATES<br>FRATES                                            |
| IRATED           |                        | Maximum rated ISP                                                       | (SEC)   | /GENF  | /(       | 568) | IMPUL                                          | I                          | IRATE                                                       |
| P1               |                        | First element in sn-plane control vector. Correto thrust                | esponds | /GENF  | /(       | 569) | BLGCON<br>Blgcon<br>Out                        |                            |                                                             |
| P 2              |                        | Second element in In-plane control vector.<br>Corresponds to deflection |         | /GENF  | /(       | 570) | BLGCON                                         | M                          | PZ                                                          |
| P3               |                        | Third element in in-plane control vector, corre                         | sponds  | /GENF  | /(       | 571) | BLGCON                                         | rs,                        | P3                                                          |

| FORTRAN | MATH   | DESCRIPTION                                                                                                  | SIOR    |        | <u>5                                    </u>                            |                                        |
|---------|--------|--------------------------------------------------------------------------------------------------------------|---------|--------|-------------------------------------------------------------------------|----------------------------------------|
| SYMBOL  | SYMBOL | OLGORII II ON                                                                                                | BLÜCK   | LOC    | 508R 60                                                                 | OE VAR                                 |
| XK1     |        | First control vector governing equation value corresponds to error in thrust                                 | /GENF / | ( 572) | BLGCON I<br>FH1 O<br>FH2 O<br>FH3 O<br>FH4 O<br>MODELA I                | XK1<br>XK1<br>XK1                      |
| X K 2   |        | Second control vector governing equation value. If non-trivial corresponds to error in moment balance        | /GENF / | ( 573) | EL1 0<br>EL2 0                                                          |                                        |
| жкз     |        | Third control vector governing equation value.<br>Corresponds to error in algebraic equation involving<br>α. | /GENF / | ( 574) | BL2 0<br>BL3 0<br>BL4 0<br>BL5 0<br>BL6 0<br>BL7 0<br>BL8 0<br>MODELA I | XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3 |
| XK1T    |        | Partial of governing equation ært state or control vector component                                          | /GENF / | ( 575) | BLGCON I<br>FH1 O<br>FH2 O<br>FH3 M<br>FH4 O<br>MODELA I                | XKIT<br>XKIT<br>XKIT                   |
| XK2T    |        | Partial of governing equation wrt state or control vector component                                          | /GENF / | ( 576) | BLGCON I<br>EL2 0                                                       | XK2T<br>XK2T                           |
| XK3T    |        | Partial of governing equation ært state or control<br>vector component                                       | /GENF / | ( 577) | BLGCON I<br>BL4 0<br>BL6 0<br>BL7 0<br>BL8 0                            | XK3T<br>XK3T                           |
| XKID    |        | Partial of governing equation wrt state or control, vector component                                         | /GENF / | ( 578) | BLGCON I<br>FH3 M                                                       |                                        |
| XK2D    |        | Partial of governing equation wrt state or control vector component                                          | /GENF / | ( 579) | ACCEL I<br>BLGCON I<br>EL1 D<br>EL2 D                                   | XK2D                                   |
| XK30    |        | Partial of governing equation wrt state or control<br>vector component                                       | /GENF / | ( 580) | BLGCON I<br>BL4 0<br>BL6 0<br>BL7 0<br>BL8 0                            | XK3D<br>XK3D<br>XK3D                   |
| XK1A    |        | Partial of governing equation wrt state or control vector component                                          | /GENF / | ( 581) | BLGCON I<br>FH3 M                                                       |                                        |
| XK2A    |        | Partial of governing equation ært state or control vector component                                          | /GENF / | ( 582) | ACCEL I<br>BLGCON I<br>EL2 0                                            |                                        |
| XK3A    |        | Partial of governing equation wrt state or control vector component                                          | /GENF / | ( 583) | BLGCON I<br>BL2 0<br>BL3 0<br>BL4 0<br>BL5 M<br>BL6 0<br>BL7 0<br>BL8 0 | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A   |
| XKIA    |        | Partial of governing equation ørt state or control vector component                                          | /GENF / | ( 584) | BLGCON I<br>FH3 M<br>FH4 0                                              | XKIV                                   |
| XK2V    |        | Partial of governing equation wrt state or control vector component                                          | /GENF / | ( 585) | EL2 0                                                                   | XX2V                                   |
| XK3V    |        | Partial of governing equation wrt state or control<br>vector component                                       | /GENF / | ( 586) | BL3 0<br>BL4 0<br>BL5 M<br>BL6 0<br>BL7 0<br>BL8 0                      | XK3V<br>XK3V<br>XK3V                   |

| FORTRAN | MATH   | DESCRIPTION                                                            |       | AFO |      | <u> </u>                               |                       |                                              |
|---------|--------|------------------------------------------------------------------------|-------|-----|------|----------------------------------------|-----------------------|----------------------------------------------|
| SYMBOL  | SYMBOL | OL CONTI I TOR                                                         | 8100  | `   | LOC  | <b>SUBR</b> (                          | יעט                   | VAR                                          |
| XK1G    |        | Partial of governing equation ært state or control vector component    | /GENF | 16  | 587) |                                        |                       |                                              |
| XU2G    |        | Partial of governing equation ært state or control vector component    | /GENF | /(  | 588) |                                        |                       |                                              |
| XK3G    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 589) | BL4<br>BL7<br>BL8                      | 0                     | XK36<br>XK36<br>XK36                         |
| XK1P    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 590) |                                        |                       |                                              |
| XK2P    |        | Partial of governing equation ært state or control vector component    | /GENF | /(  | 591) |                                        |                       |                                              |
| XK3P    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 592) | BL4<br>BL7<br>BL8                      | 0<br>0<br>0           | XK3P<br>XK3P<br>XK3P                         |
| XK1R    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 593) | FH2<br>FH3<br>FH4                      | 0<br>m<br>0           | XK1R<br>XK1R<br>XK1R                         |
| XK2R    |        | Partial of governing equation wrt state or control<br>vector component | /GENF | /(  | 594) | EL2                                    | 0                     | XK2R                                         |
| XK3R    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 595) | BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8 | 000000                | XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R |
| XK10    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 596) |                                        |                       |                                              |
| XK20    |        | Partial of governing equation ært state or control vector component    | /GENF | /(  | 597) |                                        |                       |                                              |
| XK30    |        | Partial of governing equation ært state or control vector component    | /GENF | /(  | 598) | BL4<br>BL7<br>BL8                      | 0<br>0<br>0           | XK30<br>XK30<br>XK30                         |
| XX1U    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 599) |                                        |                       |                                              |
| XK2U    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 600) |                                        |                       |                                              |
| XK3U    |        | Partial of governing equation ært state or control<br>vector component | /GENF | /(  | 601) |                                        |                       |                                              |
| XKIM    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 602) | FH3                                    | M                     | XKIM                                         |
| XK2M    |        | Partial of governing equation ort state or control vector component    | /GENF | /(  | 603) | EL2                                    | 0                     | XK2M                                         |
| XK3M    |        | Partial of governing equation wrt state or control vector component    | /GENF | /(  | 604) | 8L4<br>BL5<br>BL6<br>BL7<br>BL8        | 0<br>M<br>0<br>0<br>0 | XK3M<br>XK3M<br>XK3M<br>XK3M                 |
| PV      |        | Partial of ₱ wrt state                                                 | /GENF | /(  | 605) | BL4                                    | M                     | PV                                           |
| PG      |        | Partial of ₱ wrt state                                                 | /GENF | 70  | 606) |                                        | M                     | PG                                           |
| PP      |        | Partial of ≠ wrt state                                                 | /GENF | 70  | 607) |                                        | M                     | PP                                           |
| PR      |        | Partial of ≠ wrt state                                                 | /GENF | 70  | 608) |                                        | M                     | PR                                           |
| PD      |        | Partial of # wrt state                                                 | /GENF | 70  | 6091 |                                        | n                     | PO                                           |
| DPDY    | ∂ш/∂y  | Matrix of partials of in-plane control vector wrt<br>state             | /GENF | 70  |      | ACCEL<br>BLGCON<br>OUT                 | 1                     | DPDY<br>DPDY<br>DPDY                         |

## BLØCK PARAM

| HUHIRAN | MAIH             | DESCRIPTION                                                                                                                 | STOFA     | 11   | SUBBOUTIA                                                                                               | E USAGE                                                        |
|---------|------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------|------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| SYMBOL  | 544801           | DESCRIPTION                                                                                                                 | 91.01 K   | LOL  | 508A COU                                                                                                | E VAR                                                          |
| TPOINT  |                  | Code for each adjustable parameter in steepest descent                                                                      | /PARAM /( | 1)   | ADJUST I<br>PRMSET I<br>SDINP O<br>STAU I<br>TOPM D                                                     | IPOINT<br>IPOINT<br>IPOINT<br>IPOINT<br>IPOINT                 |
| NP AR A |                  | Number of adjustable parameters in trajectory problem                                                                       | /PARAM /{ | 13)  | ADJUST I<br>BNTG I<br>FNTG I<br>MIX3A I<br>PAY02 I<br>PRMSET I<br>SDINP M<br>STAU I<br>TEST I<br>TOPM D | NP ARA |
| NPA     |                  | Running count of number of adjustable parameters to be perturbed on remainder of trajectory                                 | /PARAM /( | 14)  | ADJUST M<br>FNTG I<br>MTX3A I<br>TOPM D                                                                 | NPAR<br>NPA<br>NPA<br>NPA                                      |
| 5PARA   | 5 <sup>₹</sup> î | Matrix of adjustable parameter sensitivities (including all parameters)                                                     | /PARAM /( | 15)  | ADJUST I<br>PAYO2 I<br>STAU M<br>TOPM D                                                                 | SPARA<br>SPARA<br>SPARA<br>SPARA                               |
| WTPB    |                  | Input or preset adjustable parameter meighting factors according to type of parameter                                       | /PARAM /( | 123) | SDINP M<br>TOPM D                                                                                       | UTPD<br>USTM                                                   |
| WTP     | [Y]              | Adjustable parameter diagonal meighting matrix order according to IPDINT.                                                   | /PARAM /( | 132) | MTX3A I<br>PAYD2 I<br>SDINP O<br>TOPM D                                                                 | WTP<br>WTP<br>WTP                                              |
| SPARB   | 5*'              | Matrix of adjustable parameter sensitivities.<br>(Contains only elements corresponding to parameters<br>yet to be adjusted) | /PARAM /( | 144) | ADJUST O<br>MTX3A I<br>TOPM D                                                                           | SPARB<br>SPARB<br>SPARB                                        |
| PARA    | Р                | Adjustable parameter nominal values.                                                                                        | /PARAM /( | 252) | ADJUST I<br>PRMSET M<br>TOPM D                                                                          | PARA<br>PARA<br>PARA                                           |
| OPAR    | δр               | Adjustable parameter corrections                                                                                            | /PARAM /( | 264) | ADJUST I<br>MTX3A M<br>TOPM D                                                                           | DPAR<br>DPAR<br>DPAR                                           |
| 521 NY  | [88]             | Parameter sensitivity contribution to A matrix                                                                              | /PARAM /{ | 276) | ADJUST O<br>MTX3A M<br>PAYO2 M<br>TOPM D                                                                | 521NV<br>521NV<br>521NV<br>521NV                               |
| DELP    |                  | Input or preset nominal parameter adjustment size                                                                           | /PARAM /( | 357) | SDINP O                                                                                                 | DELP<br>DELP                                                   |

# BLØCK RETREV

| FORTRAN | MATH   | DECCRIPTION                                                                                                                                   | STORA     | GE  | SUBROUTINE USAGE                         |                                  |  |
|---------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----|------------------------------------------|----------------------------------|--|
| SYMBOL  | SYMBOL | DESCRIPTION                                                                                                                                   | BLOCK     | LOC | 5 UBR COD                                | E VAR                            |  |
| FTIME   |        | Time at which trajectory data set is stored. (SEC)                                                                                            | /RETREV/C | 1)  | AGETB3 O<br>AST3 O<br>GETIT I<br>TRAN3 I | FTIME<br>FTIME<br>FTIME<br>FTIME |  |
| BTIME   |        | Time at which adjoint data set is stored. (SEC)                                                                                               | /RETREV/( | 2)  |                                          |                                  |  |
| MAXA    |        | Number of words in last stored partial buffer of trajectory data MAXA(1) corresponds to random file 39 MAXA(2) corresponds to random file 40. | /RETREV/( | 3)  | AGETB3 I<br>AST3 M                       | MAXA<br>Maxa                     |  |
| MAXB    |        | Number of words in last stored partial buffer of adjoint data. Corresponds to random file 41.                                                 | /RETREV/( | 5)  | BGET3 I<br>BST03 M                       | MAXB<br>Maxb                     |  |
| NBUFA   |        | Number of buffers of trajectory data stored on random files 39 and 40 respectively.                                                           | /RETREV/( | 6)  | AGETB3 I<br>AST3 A                       | NBUFA<br>NBUFA                   |  |
| IBUF1   |        | Counts number of buffers as forward trajectory is stored on random file.                                                                      | /RETREV/( | 8)  | AST3 M                                   | IBUF1                            |  |
| IBUF2   |        | Counts number of buffers as forward trajectory data is retrieved from random file.                                                            | /RETREV/( | 9)  | AGETB3 M<br>AST3 M                       | IBUF2<br>IBUF2                   |  |
| NBFA    |        | Maximum number of buffers permitted to store forward trajectory data = 20.                                                                    | /RETREV/( | 19) | AST3 I                                   | NBFA<br>NBFA                     |  |
| NBFB    |        | Maximum number of buffers permitted to store adjoint solution data = 60.                                                                      | /RETREV/( | 11) | BSTO3 I<br>TOPM D                        | NBFB<br>NBFB                     |  |
| MIXA    |        | Maximum number of words in trajectory data buffer = 990.                                                                                      | /RETREV/( | 12) | AGETB3 I<br>AST3 I<br>SDINP I<br>TOPM D  | MIXA<br>MIXA<br>MIXA<br>MIXA     |  |
| MIXB    |        | Maximum number of words in adjoint data buffer = 3000                                                                                         | /RETREV/( | 13) | BGET3 I<br>BST03 I<br>SDINP I<br>TOPM D  | MIXB<br>MIXB<br>MIXB<br>MIXB     |  |
| MXA     |        | Index of last stored word in full buffer of forward trajectory data.                                                                          | /RETREV/( | 14) | AGETB3 I<br>AST3 I<br>SDINP O            | AXM<br>AXM<br>AXM                |  |
| MXB     |        | Index of last stored word in full buffer of adjoint data.                                                                                     | /RETREV/( | 15) | BGET3 I<br>BST03 I<br>SDINP 0            | MXB<br>MXB<br>MXB                |  |
| NPTA    |        | Number of words stored at each trajectory time point.                                                                                         | /RETREV/( | 160 | SDINP M                                  | NPTA                             |  |
| NPTB    |        | Number of mords stored at each adjoint solution time point.                                                                                   | /RETREV/( | 17) | BGET3 I<br>SDINP M                       | NPTB<br>NPTB                     |  |
| IBLKB   |        | Index of adjoint data buffer where either last word was stored or retrieved.                                                                  | /RETREY/C | 18) | BGET3 M                                  | IBLKB                            |  |
| NBUFB   |        | Number of buffers of adjoint data stored on last adjoint solution.                                                                            | /RETREVY( | 19) | BGET3 I<br>BST03 0                       | NBUFB<br>NBUFB                   |  |
| IBUFB   |        | Counts number of buffers of adjoint data that have either been stored or retrieved as solution progress.                                      | /RETREV/( | 20) | BGET3 M<br>BST03 M                       | I BUFB<br>I BUFB                 |  |

BLØCK SPECØ

| FORTRAN<br>Symbol | MATH<br>Symbol      | DESCRIPTION                      | STORAGE<br>Block loc | SUBROUTINE USAGE<br>SUBR CODE VAR                         |
|-------------------|---------------------|----------------------------------|----------------------|-----------------------------------------------------------|
| บทบ2              | Σν/2 κ <sup>2</sup> | Description not input SEE SYMBOL | /SPECO /( 1)         | ANLATM 0 UMU2<br>PAT63 0 UMU2                             |
| RORR              | 2°ρ /2 κ²           | -Descriptionnot input SEE SYMBOL | /SPEC0 /( 2)         | ANLATM O RORR<br>BL7 I RORR<br>BL8 I RORR<br>PAT63 O RORR |

# BLØCK STATE3

| FORTRAN<br>Symbol | MATH<br>Symbol | DESCRIPTION                                  |          | STORAL<br>BLOCK | LOC | SUBROUT<br>SUBR C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | INF USAGE<br>DDE VAR                                                          |
|-------------------|----------------|----------------------------------------------|----------|-----------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| V                 | V              | Relative velocity                            | (FT/SEC) | /STATE3/(       | 1)  | BL4<br>BL7<br>BL8<br>CON3<br>OER3A<br>OTF3<br>ENUA3<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MOD | YAR                                       |
| VAR               | v              | State vector in steepest descent module      |          | /STATE3/(       | 1)  | YREF3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1 V                                                                           |
| GAM               | y<br>2         | Relative flight path angle                   | (RAD)    | /STATE3/(       |     | EQUA3 :<br>GUI3A :<br>DUT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                               |
| ALT               | h              | Altitude                                     |          | /STATE3/(       | 3)  | EQUA3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                               |
| M                 | •              | Mass                                         |          | /STATE3/(       | 4)  | BL8<br>EQUA3<br>OUT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 6                                                                             |
| PSI               | Ψ              | Azīmuth                                      |          | _/STATE3/(      | 5)  | 6U13A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | I PSI<br>I PSI<br>I PSI                                                       |
| RHO               | ρ              | Latitude                                     |          | /STATE3/(       | 6)  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | I RHO<br>I RHO                                                                |
| MA                | μ              | Longitude                                    |          | /STATE3/(       | 7 ) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | I MU<br>I MU                                                                  |
| нт                | Q              | Heating                                      |          | /STATE3/(       | 8 ) | OUT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | I HT                                                                          |
| DVAR              | ý              | State vector derivatives în steepest descent | module   | /STATE3/(       | 15) | ENVPRM<br>PDBC<br>PROPIN (<br>REU3<br>RKTA3A<br>SDER3 (<br>STP3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | DVAR DVAR DVAR LVD DVAR |
| ۷Đ                | v              | V derivative                                 |          | /STATE3/(       | 15) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                               |
| GÐ                | 7              | GAM derivative                               |          | /STATE3/(       | 16) | DER3A (                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | OD<br>OD                                                                      |
| но                | h              | ALT derivative                               |          | /STATE3/(       | 17) | DER3A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | СН C<br>ОН 1                                                                  |

| FORTRAN | MATH                            | DESCRIPTION                                       | STORA          |      | SUBROUTINE US                                                               |                       | USAGE                                                                                            |
|---------|---------------------------------|---------------------------------------------------|----------------|------|-----------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL                          | DE 2CH I L I I OM                                 | BLOCK          | LOC  | SUBK                                                                        | 000                   | VAR                                                                                              |
|         |                                 |                                                   |                |      |                                                                             |                       |                                                                                                  |
| MD      | •<br>m                          | mass derivative                                   | /STATE3/(      | 18}  | DER3A<br>DUT                                                                | 0<br>I                | MD<br>MD                                                                                         |
| PD      | <b>;</b>                        | Azimuth derivative                                | /STATE3/(      | 191  | DERSA                                                                       | 0                     | PSID                                                                                             |
| מפ      | •                               | Latitude derivative                               | /STATE3/(      | 201  | DER3A                                                                       | 0                     | 00                                                                                               |
| UD      | <i>P</i>                        | Longitude derivative                              | /STATE3/(      |      | DERSA                                                                       | Đ                     | UD                                                                                               |
| บย      | μ                               | Longitude Derivative                              | 757412571      | 21,  | PDBC                                                                        | ĭ                     | ÜĞ                                                                                               |
| HTD     | Ġ                               | Heating derivative                                | /STATE3/(<br>` | 22}  | DER3A<br>DUT<br>PDBC<br>PDY3A                                               | 0<br>I<br>I           | HTD<br>HTD<br>HTD<br>HTD                                                                         |
| VARL    |                                 | Array of variables for adjoint integration        | /STATE3/(      | 291  | ADEO3A<br>ADICB3<br>ADIC3A<br>PROPIN<br>RKTA3A<br>RKTB3A<br>STVRL3<br>TRAN3 | 0<br>1<br>M           | VARL<br>VARL<br>VARL<br>ZZ<br>F<br>Y<br>VARL<br>VARL                                             |
| QMAX1   |                                 | Description not input                             | /STATE3/(      | 391  | PROPIN                                                                      | 1                     | QMAX1                                                                                            |
| HDMAX1  |                                 | Description not input                             | /STATE3/(      | 42)  | PROPIN                                                                      | I                     | HDMAX1                                                                                           |
| REMAXI  |                                 | Description not input                             | /STATE3/(      | 691  | PROPIN                                                                      | I                     | REMAX1                                                                                           |
| DELY    |                                 | Description not input                             | /STATE3/(      | 71)  | RKTA3A                                                                      | M                     | DELY                                                                                             |
| DVARL   |                                 | Array of derivatives for adjoint integration      | /STATE3/(      | 128) | ADEQ3A<br>ADICB3<br>ADIC3A<br>RKTB3A                                        | 0                     | DVARL<br>DVARL<br>DVARL<br>DV                                                                    |
| RR      |                                 | Description not input                             | /STATE3/(      | 157) | MT X3A                                                                      | ĸ                     | RR                                                                                               |
| DELY    |                                 | Description not input                             | /STATE3/(      | 167) | MT X3A                                                                      | M                     | DELY                                                                                             |
| JJ      |                                 | Description not input                             | /STATE3/(      | 177) | MTX3A                                                                       | M                     | 11                                                                                               |
| YO      | yold                            | State vector of nominal trajectory                | /STATE3/(      | 227) | AST3<br>MTX3A                                                               | 9<br>I                | YB<br>Y0                                                                                         |
| SVY     | y_[                             | State and time array at previous compute interval | /STATE3/(      | 236) | OTF3<br>REU3<br>YREF3                                                       | I<br>M<br>I           | SVY<br>SVY<br>SVY                                                                                |
| XF      | λ <sup>¥</sup> i <sup>Ω</sup> J | Matrix of adjoint variables                       | /STATE3/(      | 246) | ADEQ3A ADIC3A ADIC3A ADIB3A AST3 BGET3 BST03 MTX3A OUT STAU STVRL3 TRAN3    | M M M M O I I I M     | X                                                                                                |
| YDP     |                                 | Array of state derivatives at phase end points    | /STATE3/(      | 327) | ADID3A<br>Reu3                                                              |                       | Y 0 P<br>Y 0 P                                                                                   |
| YDS     | ÿ1,,,                           | Array of state derivatives at arc end points      | /STATE3/(      | 507) | ADICB3<br>ADID3A<br>REU3<br>STAU                                            | 1                     | YDS<br>YDS<br>YDS<br>YDS<br>YDS                                                                  |
| COSGAM  | cos(7)                          | See symbol                                        | /STATE3/(      | 687) | ACCEL BL4 BL8 DER3A EQUA3 MODELA MODELA DUT PDBC PDY3A                      | I<br>I<br>I<br>0<br>0 | COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM |

| MARTRO | MAIH            | DESCRIPTION                                                         | CIORA          |      | SUBROUTINE                                                                                            |                                                                                                            |
|--------|-----------------|---------------------------------------------------------------------|----------------|------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| SYMBOL | SYMBOL          | SCOULT 110W                                                         | BLJCK          | LOC  | \$U8H 100E                                                                                            | NAN                                                                                                        |
| SINGAM | sin(7)          | See symbol                                                          | /STATE3/(      | 688) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>POBC I<br>POY3A I<br>SDER3 I | SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM                     |
| SAVBP  |                 | Saved state vector at branching point for initializing second brach | /STATE3/(      | 689) | REU3 M                                                                                                | SAVBP                                                                                                      |
| SINPSI | sın( <b>√</b> ) | See symbol                                                          | /STATE3/(      | 704) | BL4 I<br>BL8 I<br>DER3A I<br>EQUAS D<br>MODELA I<br>MODELB I<br>PDBC I<br>PDBC I                      | SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI                     |
| COSPSI | cos(♥)          | See symbol .                                                        | /STATE3/(<br>- | 705) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUAS I<br>MODELA I<br>MODELB I<br>PDBC I<br>PDBC I             | COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI                     |
| SINRHO | sin(ρ)          | See symbol                                                          | /STATE3/(      | 706) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUAS O<br>MODELA I<br>MODELB I<br>OUT I<br>PDBC I<br>PDBC I    | SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO |
| COSRHO | cοs(ρ)          | See symbol                                                          | /STATE3/(      | 707) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 M<br>MODELA I<br>MODELB I<br>OUT I<br>POBC I<br>POBC I    | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO           |
| осояно | ω×COSRHO        | See symbol                                                          | /STATE3/(      | 708) | DER3A I<br>EQUA3 M<br>MODELA I<br>MODELB I<br>POBC I<br>POY3A I                                       | OCORHO<br>OCORHO<br>OCORHO<br>OCORHO<br>OCORHO<br>OCORHO                                                   |
| OCORO2 | ω×0C0RH0        | See symbol                                                          | /STATE3/(      | 709) | DER3A I<br>EOUA3 O<br>MODELA I<br>MODELB I<br>PDY3A I                                                 | 0C0R02<br>0C0R02<br>0C0R02<br>0C0R02<br>0C0R02                                                             |
| SVBV   |                 | Saved state vector on trial trajectory                              | /STATE3/(      | 710) | ADICB3 I<br>REU3 O                                                                                    | SVBV<br>SVBV                                                                                               |
| OMESA  | ω               | Earth rotation rate (RAD/SEC                                        | ) /STATE3/(    | 719) | BL4 I<br>BL7 I<br>TOPM 0                                                                              | OMEGA<br>OMEGA<br>OMEGA                                                                                    |

| FORTRAN<br>SYMBOL | MATH<br>Symbol | DESCRIPTION                                        | STORAGE<br>BLOCK LOC | SURROUTINE USAGE<br>SUBR CODE VAR                             |
|-------------------|----------------|----------------------------------------------------|----------------------|---------------------------------------------------------------|
| OME GA2           | ω <sup>2</sup> | See symbol                                         | /STATE3/( 720)       | BL4 I OMEGA:<br>BL7 I OMEGA:<br>BL8 I OMEGA:<br>TOPM O OMEGA: |
| VDV               |                | Partial derivative of equation of motion WRT state | /STATE3/( 721)       | ADEO3A I VDV<br>PDY3A O VDV                                   |
| GDV               |                | Partial derivative of equation of motion WRT state | /STATE3/( 722)       | ADEO3A I GDV<br>PDY3A D GDV                                   |
| RDV               |                | Partial derivative of equation of motron WRT state | /STATE3/( 723)       | ADEQ3A 1 RDV<br>PDY3A 0 RDV                                   |
| MDV               |                | Partial derivative of equation of motion WRT state | /STATE3/( 724)       | ABEGSA I MOV<br>PDYSA B MOV                                   |
| PDV               |                | Partial derivative of equation of motion WRT state | /STATE3/( 725)       | ADEQ3A I PDV<br>PDY3A O PDV                                   |
| 004               |                | Partial derivative of equation of motion WRT state | /STATE3/( 726)       | ADEO3A 1 ODV<br>POY3A # ODV                                   |
| UB¥               |                | Partial derivative of equation of motion WRT state | /STATE3/( 727)       | ADEQ3A I UDV<br>PDY3A M UDV                                   |
| VDG               |                | Partial derivative of equation of motion WRT state | /STATE3/( 728)       | ADEQ3A 1 VDG<br>PDY3A 0 VDG                                   |
| GDG               |                | Partial derivative of equation of motion WRT state | /STATE3/( 729)       | ADEO3A 1 GDG<br>PDY3A 0 GDG                                   |
| RDG               |                | Partial derivative of equation of motion WRT state | /STATE3/( 730)       | ADEQ3A I RDG<br>PDY3A O RDG                                   |
| PD6               |                | Partial derivative of equation of motion WRT state | /STATE3/( 731)       | ADEQ3A 1 PDG<br>PDY3A 0 PDG                                   |
| ODG               |                | Partial derivative of equation of motion WRT state | /STATE3/( 732)       | ADED3A I DDG<br>PDY3A O ODG                                   |
| UDG               |                | Partial derivative of equation of motion WRT state | /STATE3/( 733)       | ADEQ3A I UDG<br>PDY3A O UDG                                   |
| VOR               |                | Partial derivative of equation of motion WRT state | /STATE3/( 734)       | ADEO3A 1 VDR<br>PDY3A 0 VDR                                   |
| GDR               |                | Partial derivative of equation of motion WRT state | /STATE3/( 735)       | ADEQ3A 1 GOR<br>PDY3A 0 GOR                                   |
| MDR               |                | Partial derivative of equation of motion WRT state | /STATE3/( 736)       | ADEQ3A I MOR<br>PDY3A 0 MOR                                   |
| PDR               |                | Partial derivative of equation of motion WRT state | /STATE3/( 737)       | ADED3A I PDR<br>PDY3A- O PDR                                  |
| ODR               |                | Partial derivative of equation of motion WRT state | /STATE3/( 738)       | ADEQ3A I ODR<br>PDY3A O ODR                                   |
| ROU               |                | Partial derivative of equation of motion WAT state | /STATE3/( 739)       | ADEQ3A I UDR<br>PDY3A A UDR                                   |
| MGV               |                | Partial derivative of equation of motion WRT state | /STATE3/( 740)       | ADEQ3A I VDM<br>PDY3A O VDM                                   |
| GDM               |                | Partial derivative of equation of motion WRT state | /STATE3/( ` 741)     |                                                               |
| MDM               |                | Partial derivative of equation of motion WRT state | /STATE3/( 742)       | ADEQ3A I MDM<br>PDY3A O MDM                                   |
| PDM               |                | Partial derivative of equation of motion WRT state | /STATE3/( 743)       | ADEQ3A I PDM<br>PDY3A O PDM                                   |
| YĐP               |                | Partial derivative of equation of motion WRT state | /STATE3/( 744)       | ADEQ3A I VDP<br>PDY3A O VDP                                   |
| GDP               |                | Partial derivative of equation of motion WRT state | /STATE3/( 745)       | ADERSA I GDP<br>PDYSA O GDP                                   |
| P D P             |                | Partial derivative of equation of motion WRT state | /STATE3/( 746)       | ADEQ3A I PDP<br>PDY3A O PDP                                   |
| 0 D P             |                | Partial derivative of equation of motion WRT state | /STATE3/( 747)       | ADEQ3A I ODP<br>PDV3A O ODP                                   |
|                   |                |                                                    |                      |                                                               |

| FORTRAN      | HIAN    | DESCRIPTION                                        | STORAS    |      | SUBBOUTINE                 |                                                          |
|--------------|---------|----------------------------------------------------|-----------|------|----------------------------|----------------------------------------------------------|
| SYMBOL       | SYMBOL  | DESCRIFTION                                        | ALUEK     | LÜC  | SUBR CODE                  | VAR                                                      |
| UDP          |         | Partial derivative of equation of motion WRT state | /STATE3/( | 748) |                            | UDP<br>UDP                                               |
| VDQ          |         | Partial derivative of equation of motion WRT state | /STATE3/( | 749) |                            | VD0<br>V00                                               |
| GD0          |         | Partial derivative of equation of motion WRT state | /STATE3/( | 750) |                            | GD0<br>GD0                                               |
| P00          |         | Partial derivative of equation of motion WRT state | /STATE3/( | 751) |                            | P 0 0<br>P 0 0                                           |
| <b>U</b> \$0 |         | Partial derivative of equation of motion WRT state | /STATE3/( | 752) |                            | UDO<br>UDO                                               |
| HTDV         |         | Partial decivative of equation of motion WRT state | /STATE3/( | 753) |                            | HTDV<br>HTDV                                             |
| HTDR         |         | Partial derivative of equation of motion WRT state | /STATE3/( | 754) |                            | HTDR<br>HTDR                                             |
| SIN2RO '     | sin(2ρ) | See symbol                                         | /STATE3/( | 755) | BL7 M<br>BL8 M<br>Modela O | SIN2RO<br>SIN2RO<br>SIN2RO<br>SIN2RO<br>SIN2RO<br>SIN2RO |
| COSZRO       | cos(2p) | See symbol                                         | /STATE3/( | 756) | BL7 M<br>BL8 M<br>MODELA O | COS2RO<br>COS2RO<br>COS2RO<br>COS2RO<br>COS2RO<br>COS2RO |
| COS2GM       | cos(27) | See symbol                                         | /STATE3/( | 757) |                            | COS26M<br>COS26M                                         |

# BLØCK STS

| POHIRAN<br>Symbol<br>Opay | MATH<br>SYMBOL<br>d∳ | DESCRIPTION Initial payoff improvement               | STORAGE |    |      | SUBROUTINE USAGE                                   |             |                                            |
|---------------------------|----------------------|------------------------------------------------------|---------|----|------|----------------------------------------------------|-------------|--------------------------------------------|
|                           |                      |                                                      | おしひし    | K  | LOC  | SUBR                                               | CODE        | PAR                                        |
|                           |                      |                                                      | /515    | 70 | 1)   | PAYD2<br>SDINP<br>SDINP<br>SDINP<br>TEST<br>TOPM   | I           | DPAY<br>DPAY<br>IST<br>ST<br>DPAY<br>IDPAY |
| PMIN                      |                      | Minimum payoff improvement                           | /STS    | /( | 2)   | PAYO2<br>SDINP<br>TEST                             |             | PMIN<br>PMIN<br>PMIN                       |
| MORK                      |                      | Working array, contains TOPEN1, TOPEN2, and PHIWT    | /515    | 70 | 3)   | ADEQ3A<br>FNTS<br>MODELB<br>MTX3A<br>SDINP<br>TEST | 1<br>0<br>1 | MORK<br>MORK<br>MORK<br>MORK<br>MORK       |
| ÐQ                        |                      | -Description not input SAVED PAYORE IMPROVEMENT      | /STS    | /( | 7)   | PAY02                                              | Ħ           | DQ                                         |
| CMULT                     |                      | Description not input NON-GOT, CONTROL MULTIPLIER    | /STS    | 70 | 13)  | ADEQ34                                             | 1           | CHULT                                      |
| NITER                     |                      | Maximum number of steepest descent Iterations        | /51\$   | /( | 31)  | SDI#P<br>TEST                                      |             | NITER<br>NITER                             |
| MNGA                      |                      | Control history curve number                         | /STS    | 10 | 32)  | GUI3A<br>SDINP<br>SDINP                            | 19          | MNGA<br>MNGA<br>Tal                        |
| MNGP                      |                      | Control history curve number                         | /STS    | /( | 72)  | GUI3A<br>SDINP<br>SDINP                            | 75          | MNGP<br>MNGP<br>WTPI                       |
| DLPI                      |                      | Description not input                                | /STS    | /( | 91)  | SDINP                                              | I           | DLPI                                       |
| AR                        |                      | Array for storing starting control history tables    | /STS    | /( | 112) | SDINP<br>SDINP<br>TBLK                             | 1           | AR<br>III<br>AR                            |
| IAD                       |                      | Starting address of each control history table       | /\$T\$  | /( | 312) | SDINP<br>TBLK                                      |             | I AD<br>I AD                               |
| I NP                      |                      | Index of last argument of each control history table | /STS    | /( | 332) | SDINP<br>TBLK                                      | A<br>I      | I NP<br>I NP                               |
| ISV                       |                      | Saved index of last control history table look-up    | /STS    | /( | 352) | SDINP<br>TBLX                                      | 0<br>M      | ISV                                        |

# BLØCK XCØDES

| ORTHAN<br>SYMBOL    | MATH<br>Symbol | DESCRIPTION                                                                                                                   | STORA'     | ie<br>LOC | SURROUTINE USAGE<br>SUBR CODE VAR                                                              |                                                                               |  |
|---------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------|------------|-----------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--|
| JITTOUL             |                |                                                                                                                               | 92011      |           |                                                                                                |                                                                               |  |
| ITQ                 |                | Constraint option code (internal)                                                                                             | /xcodes/(  | 1)        | ADICB3 I<br>ADIC3A I<br>ADID3A I<br>CON3 I<br>SDINP M<br>STAU I<br>TOPM- D                     | 170<br>170<br>170<br>170<br>170<br>170<br>170                                 |  |
| ICOR                |                | Phase sequence array                                                                                                          | /XCODES/(  | 10)       | AOJUST I<br>FNTG I<br>PRMSET I<br>SDINP M                                                      | ICOR<br>ICOR<br>ICOR<br>ICOR                                                  |  |
| ITI                 |                | Optimized are time flag                                                                                                       | /XCODES/(  | 30)       | ADJUST M<br>FNTG I<br>SDINP 0                                                                  | ITI<br>ITI<br>ITI                                                             |  |
| INTB                |                | Branching and intermediate constraint flag                                                                                    | /xcodes/(  | 31)       | ADIC3A I<br>BNTG I<br>ENVPRM I<br>FNTG I<br>SDINP M<br>TEST I<br>TRAN3 I                       | INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB                  |  |
| JGID                |                | Control option flag array                                                                                                     | /XCODES/(  | 32)       | BNTG I<br>FNTG I<br>SDINP M                                                                    | 7610<br>7610<br>7610                                                          |  |
| <b>1</b> bH         |                | Phase cut-off option flag                                                                                                     | /XC00E5/(  | 72)       | BNIG I<br>FNIG M<br>SDINP M                                                                    | H9L<br>H9L<br>H9L                                                             |  |
| JST                 |                | Arc cut-off option flag                                                                                                       | /XCODES/(  | 112)      | ADICB3 I<br>BNTG I<br>FNTG I<br>SDINP M                                                        | JST<br>JST<br>JST<br>JST                                                      |  |
| NCNST               |                | Number of problem constraints                                                                                                 | /xcodes/(  | 132)      | BGET3 I BST03 I CON3 I PAY02 I SOINP M SUMS I TEST I TOPM I TRAN3 I                            | NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST |  |
| NS B                |                | Number of arcs prior to branch point or intermediate constraint                                                               | /xcobes/(  | 133)      | ADICB3 I<br>BNTG I<br>ENVPRM I<br>FNTG I<br>REU3 I<br>SDINP M<br>TEST I<br>TRAN3 I<br>TRTDSZ I | NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB                          |  |
| NS A B              |                | Number of arcs on first branch                                                                                                | /XCODES/(  | 134)      | ADICB3 I<br>BNTG I<br>ENVPRM I<br>FNTG I<br>SDINP M<br>TEST I<br>TRAN3 I<br>TRTOSZ I           | NS AB<br>NS AB<br>NS AB<br>NS AB<br>NS AB<br>NS AB<br>NS AB<br>NS AB          |  |
| NI CNB              |                | Number of constraints at intermediate constraint point or at end of first branch                                              | /XCODES/(  | 135)      |                                                                                                | NI CNB<br>NI CNB<br>NI CNB<br>NI CNB<br>NI CNB<br>NI CNB                      |  |
| 120P<br>30 OCT 72 G | C 01 114       | First optimization pass flag sets d $\Phi$ = DPAY. Also used to indicate payoff degradation due to restoration of constraints | /XC00E\$/( | 136)      | TEST M                                                                                         | 120P<br>120P<br>120P                                                          |  |

| FORTRAN<br>Symbol | MATH<br>Symbol | DESCRIPTION                                                             | SIORAGE<br>Block | LUC  | SUBROUTIN<br>SUBR COO                                                                                   |                                                                       |
|-------------------|----------------|-------------------------------------------------------------------------|------------------|------|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| 1 COP             |                | Fing used to indicate state derivative refinement at arc cut-off point. | /xcooes/(        | 137) | FNTG M<br>GETIT I                                                                                       | I COP                                                                 |
| IFAW              |                | Logical file to write current trial trajectory data                     | /XCODES/(        | 138) | AST3 I<br>TOPM M                                                                                        | IFAW<br>Ifaw                                                          |
| IFAR              | •              | File where nominal trajectory data is read from                         | /XCODES/( ^      | 139) | AGETB3 I<br>AST3 I<br>TOPM M                                                                            | IFAR<br>1far<br>Ifar                                                  |
| IFB               |                | file where adjoint solution is stored                                   | /xcodes/(        | 140) | BGET3 I<br>BST03 I<br>TOPM 0                                                                            | IFB<br>IFB<br>IFB                                                     |
| IND               |                | Flag indicates whether on first nominal trajectory<br>(IND=1)           | /XCDDES/(        | 141) | AST3 I<br>BGET3 I<br>FNTG M<br>GUI3A I<br>MTX3A I<br>PROPIN I                                           | IND<br>IND<br>IND<br>IND<br>IND<br>IND                                |
| IOPEN             |                | Closed to open-loop control switch when equal to 2                      | /XCODES/(        | 142) | FNTG M<br>PROPIN O                                                                                      | IOPEN<br>Iopen                                                        |
| [PH               |                | Phase number                                                            | /xcobes/(        | 143) | ADID3A I<br>ADJUST I<br>AST3 I<br>BNTG M<br>FNTG M<br>GETIT I<br>GUI3A I<br>SDINP M                     | 1PH<br>1PH<br>1PH<br>1PH<br>1PH<br>1PH<br>1PH<br>1PH                  |
| ISPH              |                | Sign of phase cut-off                                                   | /XCODES/(        | 144) | FNTG 0<br>STP3 I                                                                                        | ISPH<br>ISPH                                                          |
| TZZ1              |                | Sign of arc cut-off                                                     | /XCODES/(        | 145) | FNTG O<br>STP3 I                                                                                        | ISST<br>ISST                                                          |
| IARC              |                | Arc humber                                                              | /xcodes/(        | 146) | ADICB3 I ADID3A I ADJUST I BNTG M ENVPRM I FNTG M GETIT MODELA I PROPB I REU3 I SDINP M STAU I TRTOSZ I | I ARCCIARCCIARCCIARCCIARCCIARCCIARCCIARC                              |
| ISTART            |                | Initialization and divergance flag                                      | /XCODES/(        | 147) | AST3 OBLGCON OBLYNE OFNTG IMPOPLA OPROPIN OFFERS ITEST MOTOPM MOTOPM                                    | ISTART |
| ITCT              |                | Iteration counter                                                       | /xcobes/(        | 148) | BNTG I<br>OUT I<br>TEST M<br>TOPM M                                                                     | 1 T C T<br>1 T C T<br>1 T C T<br>1 T C T                              |

| FORTHAN<br>SYMBOL | MAIH<br>Symbol | DESCRIPTION                                                                                | STORA<br>BLOIK | SE<br>LOC | SUBROUTING<br>SUBR CODE                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------|----------------|--------------------------------------------------------------------------------------------|----------------|-----------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21,000            | 3111000        |                                                                                            | 0 L O · N      |           | 2090 0000                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| ITER              |                | Trajectory pass indicator.  ITER = 1, CONSTRAINTS = 2, DPTIMIZATION = 3, SOLUTION          | /XCODES/(      | 149)      | AST3 I<br>FNTG I<br>GETIT I<br>MODELA I<br>OUT I<br>PAYO2 M<br>PROPIN I<br>TEST M<br>TOPM M       | ITER ITER ITER ITER ITER ITER ITER ITER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| I VAR             |                | Cut-off variable option indicator                                                          | /XCODES/(      | 150)      | FNTG M<br>STP3 O<br>TOL3 I                                                                        | IVAR<br>IVAR<br>IVAR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 1K                |                | Integration routine flag tells which derivative evaluation in Runge-Kutta cycle            | /xcooes/(      | 151)      | ADIC3A M<br>BNTG I<br>MODELA I<br>PAYO2 M<br>RKTA3A M<br>RKTB3A M                                 | JK<br>JK<br>JK<br>J                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| JPS               |                | Absolute value of phase cut-off option code                                                | /xcodes/(      | 152)      | ADID3A I<br>BNTG M<br>FNTG M<br>STP3 I<br>TOL3 I                                                  | JPS<br>JPS<br>JPS<br>JPS<br>JPS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| J2                |                | Absolute value of arc cut-off option code                                                  | /xcodes/(      | 153)      | ADICB3 M<br>ADIC3A I<br>ADID3A I<br>BNTG M<br>FNTG M<br>PROPB I<br>PROPIN I<br>STP3 I<br>TOL3 I   | 72<br>72<br>72<br>72<br>72<br>72<br>72<br>72                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| KOP               |                | Counts number of times constraint misses are halved<br>down because of divergance problems | /XCODES/C      | 154)      | TEST M<br>TOPM I                                                                                  | KOP<br>Kop                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| KPST              |                | Controls logic for compute interval during adjoint integration                             | /XCODES/(      | 155)      | BNTG M<br>FNTS M                                                                                  | KPST<br>KPST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| K                 |                | Storage retrieval flag indicates end of arc, phase, or data                                | /xc00ES/(      | 156)      | AST3 O<br>FNTG O<br>GETIT M<br>MODELA I<br>SDINP M                                                | K<br>K<br>K<br>K                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| KST               |                | Arc or phase cut-off flag                                                                  | /XCDDES/(      | 157)      | ADJUST I<br>FNTG M                                                                                | KST<br>KST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| NCASE             |                | Case number                                                                                | /XCDDES/(      | 159)      | TOPM 0                                                                                            | NEASE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| NCN               |                | Number of elements in d <b>∜</b>                                                           | /xcodes/(      | 160)      | ADECISA I ADICSA I ADICSA I ADIUST I ADIUST I ASTS M BSTOS I MTXSA I DUT 2 TEST M TRANS I TRANS I | NCH NCCH NCCH NCCH NCCH NCCH NCCCH NCCCCH NCCCCH NCCCCH NCCCC NCCCH NCCCC NCCC NCCCC NCCC N |
| NEOB              |                | Number of integrated quantities during adjoint solution                                    | /xcodes/(      | 161)      | ADICB3 I<br>ADIC3A M<br>RKTB3A I                                                                  | NEQB<br>NEQB<br>NN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| FORTRAN | MAIH   | DESCRIPTION                                                                                                       | STORAL    |      | SUBROUTIN                                                                                                                                             |                                                                    |
|---------|--------|-------------------------------------------------------------------------------------------------------------------|-----------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| SYMBOL  | SYMBOL | DESCRIPTION                                                                                                       | BLOCK     | LOC  | SUBA COD                                                                                                                                              | E VAR                                                              |
| NEQ     |        | Number of integrated states                                                                                       | /XCODES/( | 162) | ADICB3 I<br>ADIC3A I<br>ADIC3A I<br>AGET83 I<br>AST3 I<br>BGET3 I<br>MTX3A I<br>GUT I<br>REU3 I<br>SDER3 I<br>SDER3 I<br>SDER3 I<br>TOPM I<br>TRANS I | NEG<br>NEG<br>NEG<br>NEG<br>NEG<br>NEG<br>NEG<br>NEG<br>NEG<br>NEG |
| NOP     |        | Counts number of times payoff is scaled down due to divergence problems                                           | /XCODES/( | 163) | TEST M<br>TOPM I                                                                                                                                      | NOP<br>NOP                                                         |
| NPH     |        | Number of phases in trajectory                                                                                    | /XCODES/( | 164) | BNTG I<br>FNTG O<br>PRMSET I<br>SDINP M<br>TEST I<br>TOPM I                                                                                           | NPH<br>NPH<br>NPH<br>NPH<br>NPH<br>NPH                             |
| N       |        | Description not input                                                                                             | /XCODES/( | 165) | MTX3A M<br>Pay02 M<br>Sdinp M                                                                                                                         | N<br>N<br>N                                                        |
| NST     |        | Number of arcs in trajectory                                                                                      | /xcodes/( | 166) | BNTG I<br>FNTG D<br>PROPB I<br>SDINP I<br>SDINP M<br>TEST I<br>TOPM I<br>IRAN3 I                                                                      | NST<br>NST<br>NS<br>NS<br>NST<br>NST<br>NST<br>NST                 |
| IPST    |        | Phase counter for first nominal trajectory                                                                        | /XCODE5/( | 167) | AST3 I<br>FNTG M<br>GUI3A I<br>REU3 I                                                                                                                 | IPST<br>IPST<br>IPST<br>IPST                                       |
| IPRINT  |        | Print page counter initialization flag                                                                            | /xcodes/( | 168) | OUT M<br>TEST 1<br>TOPM 0                                                                                                                             | IPRINT<br>IPRINT<br>IPRINT                                         |
| ISTN    |        | Stored history data arc number                                                                                    | /xcobes/( | 169) | AGETB3 0<br>AST3 0<br>GETIT I<br>TRAN3 I                                                                                                              | ISTN<br>ISTN<br>ISTN<br>ISTN                                       |
| IPHN    |        | Stored history data phase number                                                                                  | /XCODES/( | 170) | AGETB3 M<br>AST3 M<br>GETIT I                                                                                                                         | IPHN<br>IPHN<br>IPHN                                               |
| IBLK1   |        | Storage retrieval buffer counter                                                                                  | /xcobes/( | 173) | AST3 M<br>BST03 M                                                                                                                                     | IBLK1<br>IBLK1                                                     |
| IBLK2   |        | Storage retrieval buffer counter                                                                                  | /XCODES/( | 174) | AGETB3 M                                                                                                                                              |                                                                    |
| ISTOP   |        | Arc cut-off flag                                                                                                  | /XCODES/( | 175) |                                                                                                                                                       | ISTOP<br>ISTOP                                                     |
| ISTPP   |        | Phase cut-off flag                                                                                                | /XCODES/( | 176) |                                                                                                                                                       | ISTPP<br>ISTPP                                                     |
| L       |        | Integration traffic control flag L = 1 means evaluate derivatives = 2 check cut-off = 3 print or cut-off detected | /xcodes/( | 177) | BNTG M<br>FNTG M<br>OUT I<br>RKTA3A M<br>RKTB3A M<br>SDINP M                                                                                          |                                                                    |

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| FORTRAN      | MATH        | DESCRIPTION                                                             | SIGRAG             | LDC<br>LDC | <u> </u>                                                                                         |                                              |
|--------------|-------------|-------------------------------------------------------------------------|--------------------|------------|--------------------------------------------------------------------------------------------------|----------------------------------------------|
| SYMBOL       | 5 Y M B O L | 2.00111111011                                                           | BLUCK              | CUC        | JUBN CO                                                                                          | DE AMU                                       |
| 1F08         |             | Forward or adjoint integration flag = 1 means forward = 2 means adjoint | /XCODES/(          | 178)       | ACCEL I<br>BEROCO I<br>BLYNE I<br>EQUA3 I<br>IMPUL I<br>SPLYNE I<br>TOPM 0                       | IFOB<br>IFOB<br>IFOB<br>IFOB                 |
| NB 1         |             | Extent of integration set during adjoints on branch problem             | /XCODES/(          | 179)       | ADEQ3A I<br>ADICB3 M<br>ADIC3A M<br>BNTG O<br>RKTB3A I<br>STVRL3 I                               | NB<br>NB<br>NB                               |
| LB           |             | First element number in partitioned d∳ vector                           | /XCODES/(          | 180)       | ADEQ3A I<br>ADIC83 O<br>ADIC3A M                                                                 | LB                                           |
| MB           |             | Last element number in partitioned d¥ vector                            | /xcodes/(          | 181)       | ADEQ3A I<br>ADICB3 O<br>ADIC3A O                                                                 | MB                                           |
| NPHP         |             | Description not input                                                   | /xcobes/(          | 182)       | REU3 0<br>TEST I                                                                                 |                                              |
| NPHB         |             | Description not input                                                   | /XCODES/(          | 183)       | REU3 O                                                                                           |                                              |
| NCTIN        |             | Number of elements in upper triangular portion of A                     | /XCODES/(          | 184)       | ADICB3 I                                                                                         |                                              |
| NEQF         |             | Number of equations to be integrated on forward trajectory              | /xcodes/(          | 185)       | REU3 I<br>RKTA3A I<br>SDINP O<br>STAU I<br>TOPM O<br>TRAN3 O                                     | NN<br>NEQF<br>NEQF<br>NEQF                   |
| JIN          |             | Description not input                                                   | /xcodes/(          | 186)       | EQUAS I<br>MODELA M<br>MODELB O<br>PROPIN O                                                      | JIN<br>ILAB                                  |
| INEDS        |             | Description not input                                                   | /xcodes/(          | 187)       | BNTS I                                                                                           |                                              |
| JPRP         |             | Propulsion flag for different rocket options                            | /xco <u>des</u> /( | 194)       | ACCEL I<br>DERSA I<br>EQUAS I<br>MODELA I<br>PDYSA I<br>PROPB O<br>PROPIN O                      | JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP         |
| <b>J</b> @11 |             | Control option                                                          | /xcodes/(          | 195)       | ACCEL I<br>BNTG (<br>DER3A I<br>FNTG M<br>GUI3A I<br>MODELB I<br>MODELB I<br>MODELB I<br>POY3A I | JGII<br>JGII<br>JGII<br>JGII<br>JGII<br>JGII |
| MTT          |             | Thrust curve number                                                     | /XCODES/(          | 196)       | PROPE A                                                                                          | TIM I                                        |
| MPIN         |             | Save thrust curve numbers for adjoint solution                          | /XCODES/(          | 197)       | PROPB 1<br>PROPIN (                                                                              |                                              |
| JP1          |             | Option flag for first governing equation                                | /xcodes/c          | 217)       | AGETB3 MAST3 MODELA MODELB I PROPB C                                                             | 9 JP1<br>9 JP1<br>1 JP1<br>9 JP1             |

| FORTRAN<br>Symbol | MATH<br>Symbol | DESCRIPTION                               | <u>STORAGE</u><br>Block loc | SUBROUTINE USAGE<br>SUBR CODE VAR                                                          |
|-------------------|----------------|-------------------------------------------|-----------------------------|--------------------------------------------------------------------------------------------|
| JP2               |                | Option flag for second governing equation | /XCODES/( 218               | B) MODELA I JP2<br>MODELB I JP2<br>PROPB O JP2<br>PROPIN O JP2                             |
| JP3               |                | Option flag for third governing equation  | /XCODES/( 219               | 9) AGETB3 0 JP3<br>AST3 m JP3<br>MODELA m JP3<br>MODELB I JP3<br>OUT I JP3<br>PROPIN 0 JP3 |

## SUBRØUT I NE ACCEL

#### Subroutine ACCEL

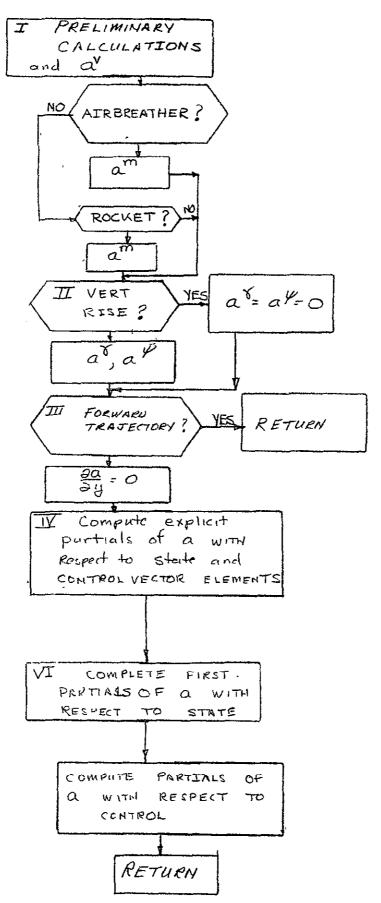
### Purpose

Computes acceleration vector, a, and its partials with respect to state and elements of the control vector. It also computes the complete first partials of the acceleration vector with respect to the state. See Section 9.3 of Volume I.

### Description

During forward trajectory,  $a^V$ ,  $a^V$ ,  $a^{\Psi}$  and  $a^{m}$  are computed. On the adjoint solution, matrix  $\frac{\partial a}{\partial y}$  is also computed. The acceleration vector a is defined in equation (2.4-2) of Volume I.

## SUBROUTINE ACCEL



| FORTHAN<br>Symbol | MATH<br>Symnöt | CODE | DESCRIPTION                                                          | <u>\$1</u><br> | QRA, | LOC  | <u>504R00</u><br>508R                             |                       | E VAR                      |
|-------------------|----------------|------|----------------------------------------------------------------------|----------------|------|------|---------------------------------------------------|-----------------------|----------------------------|
| AE                | Agait          | 1    | Total nozzie exit erea                                               | /GENF          | 70   | 520) | ACCEL<br>FH2<br>IMPUL<br>PROPB<br>PROPIN<br>SOER3 | I<br>I<br>0<br>0<br>I | AE<br>AE<br>AE<br>AE<br>AE |
| AG                | a <sup>7</sup> | M    | Acceleration vector element.                                         | /AXL           | 70   | 2)   | ACCEL<br>DERSA<br>POYSA                           | M<br>I<br>I           | AG<br>AG<br>AG             |
| AGA               |                | u    | Element of AW matrix                                                 | /ACCEL         | /(+  | )    | ACCEL                                             | ¥                     | AGA                        |
| AGD               |                | ы    | Element of AW matrix                                                 | /ACCEL         | /(*  | }    | ACCEL                                             | ы                     | A GO                       |
| AGM               |                | 0    | Element of watrix of acceleration vector partials WRT state.         | /AXL           | 70   | 30)  | ACCEL<br>PDY3A                                    | 0                     | A GM<br>A GM               |
| AGR               |                | 0    | Element of matrix of acceleration vector partials WRT state.         | /AXL           | /(   | 18}  | ACCEL<br>PDY3A                                    | 0<br>I                | AGR<br>AGR                 |
| AGT               |                | 0    | Element of AW watrix                                                 | /ACCEL         | /(+  | )    | ACCEL                                             | 0                     | AGT                        |
| AGV               |                | 0    | Element of matrix of acceleration vector partials WRT state.         | /AXL           | 70   | 6)   | ACCEL<br>PDY3A                                    | Į                     | AGV<br>AGV                 |
| AM                | a <sup>n</sup> | M    | Acceleration vector element.                                         | /AXL           | /(   | 4)   | ACCEL<br>DER3A                                    | Ħ                     | AM<br>AM                   |
| AMR               |                | 0    | Element of matrix of acceleration vector partials WRT state.         | /AXL           | 70   |      | ACCEL<br>PDY3A                                    | I                     | amr<br>amr                 |
| TMA               |                | W    | Element of AW matrix                                                 | /ACCEL         | /(*  |      | ACCEL                                             | ы                     | TMA                        |
| AMV               |                | 0    | Element of matrix of acceleration vector partials WRT state.         | /AXL           | /(   |      | ACCEL<br>PDY3A                                    | 0<br>I                | VPIA<br>VPIA               |
| AP                | a*             | M    | Acceleration vector element,                                         | /AXL           | /(   | 3)   | ACCEL<br>DER3A<br>PDY3A                           | M<br>I<br>I           | AP<br>AP<br>AP             |
| APA               |                | W    | Element of AW matrix                                                 | /ACCEL         | /(+  | )    | ACCEL                                             | u                     | APA                        |
| APD               |                | พ    | Element of AW matrix                                                 | /ACCEL         | /(*  | )    | ACCEL                                             | W                     | APD                        |
| APM               |                | 0    | Element of matrix of acceleration vector partials WRT state.         | /AXL           | /(   | 31)  | ACCEL<br>PDY3A                                    | 0                     | APM<br>APM                 |
| APR               |                | ð    | Element of matrix of acceleration vector partials was state.         | /AXL           | 10   | 19)  | ACCEL<br>PDY3A                                    | Đ<br>I                | APR<br>APR                 |
| APT               |                | Đ    | Element of AW matrix                                                 | /ACCEL         | /(+  |      | ACCEL                                             | 0                     | APT                        |
| APV               |                | o    | Element of matrix of acceleration vector partials WRT state.         | /AXL           | 70   |      | ACCEL<br>PDY3A                                    | e<br>I                | APV                        |
| AV                | av             | m    | Acceleration vector element.                                         | /AXL           | /C   |      | ACCEL<br>DER3A                                    | A                     | AV                         |
| AVA               |                | W    | Element of AW matrix                                                 | /ACCEL         |      |      | ACCEL                                             | ᇤ                     | AVA                        |
| AVD               |                | n    | Element of AW matrix                                                 | /ACCEL         |      |      | ACCEL                                             | W                     | AVD                        |
| AVM               |                | 0    | Element of matrix of acceleration vector partials WRT state.         | /AXL           | κ    |      | ACCEL<br>PDY3A                                    | 0<br>1                | AVA                        |
| AVR               |                | 0    | Element of matrix of acceleration vector partials WRT state.         | /AXL           | 70   |      | ACCEL<br>PDY3A                                    | 1                     | A VR<br>A VR               |
| AVT               |                | W    | Element of AW matrix                                                 | /ACCEL         |      |      | ACCEL                                             | ы                     | AVT                        |
| AVV               |                | M    | Name of acceleration partials matrix.                                | /AXŁ           | /(   | 5)   | ACCEL<br>ACCEL<br>PDY3A                           | M<br>0<br>1           | 44A<br>44<br>44A           |
| WA                | ∂a/∂ш          | 0    | Matrix of partials of acceleration vector WRT inplane control vector | /ACCEL         | /(*  | )    | ACCEL                                             |                       | AW                         |
| AY                |                | 8    | Name of acceleration partials matrix.                                | /AXL           | /(   | 5)   | ACCEL<br>ACCEL<br>PDY3A                           | M<br>0<br>I           | AVV<br>AV<br>AVV           |

30 OCT /2 G 01-46

| ORTHAN | MAIH                    | 1005 | DESCRIPTION                               | AI .          | STARA     |      | SUBROU                                                                               | IINE                                 | USAGE                                                                                  |
|--------|-------------------------|------|-------------------------------------------|---------------|-----------|------|--------------------------------------------------------------------------------------|--------------------------------------|----------------------------------------------------------------------------------------|
| SYMBUL | SYMBOL                  | (002 | DE JUIT 1 TO                              | V             | BLU.K     | LOC  | 5084                                                                                 | CODE                                 | VAR                                                                                    |
| CODAE  | cos( a~6 <sub>E</sub> ) | I    | See symbol                                |               | /GENF /(  | 549) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>SDER3                                    | I<br>I<br>I<br>I<br>I<br>I           | CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE                   |
| COSA   | cos∝                    | I    | See symbol                                |               | /AEC03 /6 | 8)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>OUT<br>VT                                | I<br>I<br>I<br>I<br>I<br>I           | COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA                                   |
| COSGAM | cos(?)                  | ī    | See symbol                                |               | /STATE3/( | 687) | ACCEL<br>BL4<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>OUT<br>PDBC<br>PDY3A    |                                      | COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM |
| COSPHI | cos¢                    | I    | See symbol                                | •             | /AEC03 /( | 13)  | ACCEL<br>BL4<br>GUI3A<br>MODELA<br>MODELB<br>OUT                                     |                                      | COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI                               |
| DB     | D <sub>b</sub>          | I    | Base drag                                 | (LBS)         | /GENF /(  | 537) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>OUT<br>SDER3<br>VT              | I<br>I<br>I<br>I<br>I<br>I<br>I<br>I | 08<br>08<br>08<br>08<br>08<br>08<br>08                                                 |
| DBR    |                         | 1,   | Partial of base drag wrt altitude         |               | /GENF /(  | 536) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>VT                              | I<br>I<br>I<br>I<br>I<br>I<br>I      | DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR                                          |
| DPDY   | 9m/9y                   | I    | Matrix of partials of In-plane contistate | ol vector mrt | /GENF /   | 610) | ACCEL<br>BLGCON<br>OUT                                                               | I                                    | DPDY<br>DPDY<br>DPDY                                                                   |
| DRAG   | D                       | 1    | Aerodynamic drag                          | (LBS)         | /GENF /(  | 497) | ACCEL<br>BL5<br>BL7<br>BL8<br>ENVPRM<br>FH3<br>OUT<br>PROPB<br>PROPIN<br>SDER3<br>VT | I<br>I<br>I<br>I<br>I<br>I<br>I      | DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG                           |

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE                                        | DESCRIPTION               |                                      | BLOCK   | PAGE<br>LOC | <u>S UB H</u><br>S UB I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 003 F                   | F USAGE<br>E VAR                                   |
|-------------------|----------------|---------------------------------------------|---------------------------|--------------------------------------|---------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------------------------------------------|
| DRAGA             |                | I Partial of drag                           | ; wrt angle of attack     |                                      | /GENF   | /( 53       | H) ACCE<br>BL5<br>BL7<br>BL8<br>FH3<br>VT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | . I<br>I<br>I<br>I<br>M | ORAGA<br>ORAGA<br>ORAGA<br>ORAGA<br>ORAGA<br>ORAGA |
| DRAGR             |                | I Partial drag er                           | t altitude                |                                      | / GENF  | /L 53       | BL5<br>BL5<br>BL7<br>BL8<br>FH3,<br>VT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | - 1<br>I<br>I<br>I<br>M | DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR |
| DRAGV ,           |                | I Partial of drag                           | ; wrt velocity            |                                      | /GENF   | /( 53       | P) ACCES<br>BL5<br>BL7<br>BL8<br>FH3<br>VT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | - I<br>I<br>I<br>I<br>M | DRAGV<br>DRAGV<br>DRAGV<br>DRAGV<br>DRAGV<br>DRAGV |
| FVAC              |                | I Total vacuum th                           | rust [rocket]             | (LBS)                                | /GENF   | /( 52       | B) ACCEI<br>EQUA:<br>FH2<br>IMPUI<br>PROPI<br>PROPI<br>SOER:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3 M<br>I<br>- M<br>3 M  | FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC       |
| GDA               | 3 <b>7/3</b> ∝ | O See symbol                                | •                         |                                      | /AECO3  | /(          | ACCEI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | O I A                   | GDA<br>GDA                                         |
| GDPH              | a2/a¢          | 0 See symbol                                |                           |                                      | /AEC03  | /( 1        | ACCEI<br>ADEQ:<br>PDY3/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | BA I                    | GDPH<br>GDPH<br>GDPH                               |
| GR                | gr             | I Gravitational a                           | cceleration at surface of | the earth.<br>(FT/SEC <sup>2</sup> ) | /GŁOBAI |             | ACCEI<br>BLD ACCEI<br>BLD ACCEINI<br>GEINI<br>GEINI<br>GEINI<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PADS:<br>PA |                         | 68 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8             |
| IFOB              |                | I Forward or adjo<br>= 1 means<br>= 2 means |                           |                                      | /XCODE: | 5/( 17      | B) ACCEI<br>BERDI<br>BLYNI<br>EQUA:<br>IMPUI<br>SPLYI<br>TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 20 I                    | IFOB<br>IFOB<br>IFOB<br>IFOB<br>IFOB<br>IFOB       |
| 15P               | Isp            | I Net vacuum spec                           | :ific impulse             |                                      | /GENF   | /( 53       | B) ACCE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | LI                      | ISP<br>ISP                                         |
| ISPF              | -              | I Partial of ISP                            | ert vacuum thrust         |                                      | /GENF   | /( 53       | 9) ACCE<br>Impu                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | LI                      | ISPF<br>ISPF                                       |

| FORTHAN                   | MATH:   | CODE       | DESCRIPTION                                                  |             | ARSTE      |      | SUBROUTINE                                                                                      |                                                              |
|---------------------------|---------|------------|--------------------------------------------------------------|-------------|------------|------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| SYMBOL                    | SYMBOL  |            | 5.00111 11014                                                | <del></del> | BLOCK      | LÜL  | SUBA LODE                                                                                       | VAR                                                          |
| 1611                      |         | I          | Control option                                               |             | /XCODE5/(  | 195) | ACCEL I<br>BNTG D<br>DER3A I<br>FNIG M<br>GVI3A I<br>MODELA I<br>MUDELB I<br>MIX3A I<br>PDY3A I | 1611<br>1611<br>1611<br>1611<br>1611<br>1611                 |
| JPRP                      |         | I 1        | Propulsion flag for different rocket opt                     | ions        | /XCODE\$/( | 194) | ACCEL I<br>DER3A I<br>EQUAS I<br>MODELA I<br>POY3A I<br>PROPB O<br>PROPIN O                     | JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP         |
| LIFT                      | L       | Ť ,        | Aerodynamic ilft                                             | (LB\$)      | /GENF /(   | 496) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>ENVPRM I<br>FH3 I<br>OUT I<br>PROPB D<br>PROPIN D<br>VT O | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT |
| LIFTA                     |         | I I        | Partial of lift wrt angle-of-attack                          |             | /GENF /(   | 531) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT O                                             | LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA           |
| LIFTM                     |         | <b>1</b> i | Partial of LIFT wrt mass                                     |             | /GENF /(   | 535) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT 0                                             | LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM           |
| LIFTR                     |         | 1          | Partial of lift wrt altitude                                 | •           | /SENF /(   | 530) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT \ 0                                           | LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR           |
| LIFTV                     |         | I          | Partial of lift wrt velocity                                 |             | /GENF /(   | 529) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT 0                                             | LIFTY<br>LIFTY<br>LIFTY<br>LIFTY<br>LIFTY                    |
| M                         | **      | I          | Mass                                                         |             | /STATE3/(  | 4)   | ACCEL I<br>BL4 I<br>BL8 I<br>EQUA3 I<br>OUT I<br>SDER3 I                                        | М<br>М<br>М<br>М                                             |
| PAR                       |         | 1          | Der:v Of press Wrt alt.                                      |             | /GENF /(   | 312) | ACCEL I<br>FH2 I                                                                                | PAR<br>PAR                                                   |
| PDA                       | ∂•⁄/∂∝  | 0          | See symbol                                                   |             | /AEC03 /(  | 6)   | ACCEL 0                                                                                         | PDA<br>PDA                                                   |
| POPH                      | a•∕/a¢  | 0          | See symbol .                                                 |             | /AEC03 /(  | 15)  | ACCEL O<br>ADERSA I<br>PDYSA O                                                                  | PDPH<br>PDPH<br>PDPH,                                        |
| SFC                       |         | . 1        | Specific fuel consumption                                    | (LBS/LB/HR) | /AIRBRE/(  | 4 )  | ACCEL I                                                                                         | SFC                                                          |
| SFCH<br>SFCV<br>30 OCT 72 | G.01-46 |            | Partial of SFC WRT altitude.<br>Partial of SFC WRT velocity. |             | /AIRBRE/(  |      | ACCEL I                                                                                         | SFCH<br>SFCV                                                 |

| FORTRAN | MAIH                   | CODE DESCRIPT                   | TION         | STORA      |      | <u> 5 บ จ ค อ บ T I</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                      |
|---------|------------------------|---------------------------------|--------------|------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| SYMBOL  | SYMBOL                 | DESCRIPT                        | - 1 U IV     | BLOCK      | LOL  | SUBH LO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | DE VAR                                               |
| SIDAE   | sin(a-s <sub>E</sub> ) | I See symbol                    |              | /GENF ./(  | 557) | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>FH3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE            |
| SINA    | sîn∝                   | I See sy≡bol .                  |              | /AEC03 /(  | 7)   | ACCEL II<br>BC4 II<br>BL6 II<br>BL7 II<br>BL8 II<br>GUI34 M<br>OUT II<br>VT M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA |
| SINFHI  | sın¢                   | I See symbol                    |              | /AEC03 /(  | 12)  | ACCEL I<br>BL4 I<br>MODELA M<br>MODELB M<br>OUT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | SINPH:                                               |
| T       | T                      | I Thrust                        | (LBS)        | ·/GENF· /( | 411) | ACCEL I<br>BLGCON M<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>EQUA3 O<br>FH1 I<br>FH2 I<br>FH3 I<br>FH4 I<br>I MPUL I<br>OUT I<br>PROPB O<br>PROPIN O<br>REU3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ;<br>;<br>;<br>;<br>;<br>;<br>;<br>;<br>;            |
| TAIRBH  |                        | 1 Partial of airbreather thrust | WRT altitude | /AIRBRE/(  | 3)   | ACCEL I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | TAIRBI                                               |
| TAIRBY  |                        | I Partial of airbreather thrust | WRT velocity | /AIRBRE/(  | 2)   | ACCEL I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | TAIRB                                                |
| V       | v                      | I Relative velocity             | - (FT/SEC)   | /STATE3/(  | 1)   | FH4 I I ACCEL OF ACCEL OF ACCEL OF ACCEL OF ACCED OF ACCE | VAR              |

| FORTHAN<br>SYMBOL | MATH<br>Symbol | CODE | DESCRIPTION                                                         | 5 T C<br>8 L U C K | )RA5 | €    | <u>5 ปรค บ</u><br>5 ปริห      |   |                              |
|-------------------|----------------|------|---------------------------------------------------------------------|--------------------|------|------|-------------------------------|---|------------------------------|
| VDA               | 0°/∂∝          | 0    | See symbol                                                          | /AEC03             | /(   | 4)   | ACCEL<br>ADERSA               |   | VDA<br>VDA                   |
| XK2A              |                | I    | Partial of governing equation art state or control vector component | /GENF              | /(   | 582) | ACCEL<br>Blgcon<br>El2        | Ī | XK2A<br>XK2A<br>XK2A         |
| XK2D              |                | I    | Partial of governing equation ært state or control vector component | /GENF              | /(   | 579) | ACCEL<br>BLGCON<br>EL1<br>EL2 | Ī | XK2D<br>XK2D<br>XK2D<br>XK2D |

```
ACCEL
COMM
COMM
COMM
COMM
GLOBAL
SLOBAL
GLOBAL
                     1.
2.
3
4
5.
1.
   SUBROUTINE ACCEL
  0000
  COMPUTES ACCELERATION VECTOR AND ITS PARTIALS WITH RESPECT TO STATE
  8.
   SLOBAL
SLOBAL
RETAP
              9.
10.
               11.
12
13
14
15
16.
17
18
19.
20
21
   GENF
GENF
GENF
GENF
GENF
GENF
GENF
GENF
   , NDC(2G)
, OTP
, QS
, CS
, SUMSQ
, TR(9)
   OMP
TBU(20)
MACHV
DRAGA
ISPF
ULFTA
CODAE
SID
   GENF
GENF
GENF
GENF
GENF
GENF
   , GAMMAD
   , XKG
  , XKP
   GENF
GENF
   ,
  XK2
XK20
XK2V
XK2P
XK20
XK2H
PO
   , XK3D
, XK3V
, XK3P
, XK3D
, XK3M
   GENF
GENF
GENF
GENF
GENF
GENF
  , XK1
, XK1D
, XK1V
, XK1P
, XK10
, XK1M
, PR
  DPDY(3)
   GENF
FRAT
GENF
GENF
   AECO3
AECO3
   ALPHA YDA
PHIO PHID
PDPH XLAMA(9)
FK XCGH
CMAM CHM CMO
CLA CLM
  GDA
PHI
XLAMP(9)
ZCGM
CMOM
   PDA
SINPHI
CDG
CLOM
FKM
   AECO3
AECO3
AECO3
AECO3
  , CHOM , FKM , AECO3 AECO3 AECO3 AECO3 AECO3 AECO3 CODES AECO3 CODES AECO3 AEC
  61
62
63
65
66
67
71
72
73
   (9), CDSPSI
(9), CMEGA
(DV
VDG
VDG
VDR
PDP
UDO
DM , MDV, MDR
   OMEE
ROV
GOS
GOR
GON
OOP
HTOV
  , MDV
, RDG
, MDR
, HDM
, UDP
, HTDR
   *40A
   *UD6
*UDR
*60P
*PD0
   REAL MOM ,
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```
STATE3D
STATE3D
EQUV3
EQUV3
EQUV3
   86
   81.
82.
83.
84.
85.
86.
87.
   EQUV3
   AXL
AXL
AXL
AXL
AXCCEL
ACCEL
ACCEL
ACCEL
ACCEL
ACCEL
ACCEL
ACCEL
ACCEL
88.
89.
90.
91.
92.
93.
94.
95.
C
97.
98.
99.
100.
102.
103.
C
  COMM
  ACCEL
ACCEL
ACCEL
  ACCEL
ACCEL
PO14
FIXED
  1 G-
105.
   JULY28
  12-
  FIXED
107.
  FIXED
108.
                               UDATINUE
IF(JEII EQ 8) GO TO 40
II TEST FOR VERTICAL RISE OR PITCHOVER
AX = (TSDAE - DBSA + LIFT)/M
AG = AX+COSPHI
AP = AX+SINPHI
GO TO 45
  FIXED
ACCEL
169.
110.
111.
112.
113.
  46-
  COMN
ACCEL
ACCEL
                C
114.
115.
  ACCEL
  ACCEL
116.
                        40 AG=9.
  ACCEL
                               AP=0.
111 IF FORWARD TRAJECTORY RETURN
  ACCEL
COMN
                     III IF FORWARD TRAJECTORY RETURN

45 IF(IFOB.EQ.1) RETURN

DO 46 I=1,28

46 AY(I)=0.

DEBRCA = DEBR*COSA

OBRSA = DEBR*SINA

IV *** ***

COMPUTE THE EXPLICIT FIRST PARTIALS OF THE A-VECTOR WITH RESPECT

TO THE STATE AND DECISION VECTORS.

51 AYV = -ORAGY/M

AVR = (-DEBRCA - DRAGR)/M

AVR = AV/M

IF(AM.EO 0.) GO TO 53

IF(JPRO.NE.2) GO TO 52

ART = -SFC.75600./GR

AGR = AMI*TAIRBH - I*SFCH/GR/3600.

ANV = AMI*TAIRBY - I*SFCH/GR/3600.

GO TO 54
119
120.
  ACCEL
  ACCEL
  ACCEL
ACCEL
121.
122.
123.
124.
125.
126.
127.
128
129
130.
131.
  COMM
  ACCEL
ACCEL
  ACCEL
   P014
F1XED
JULY28
JULY28
JULY28
  53·
52·
132.
133.
134.
135.
                                GD TO 54
  FIXED
                       52 CONTINUE
ANT =-(1. - ISPF*FVAC/ISP)/GEISP
ANR = AE*PAR*ANT
GO TO 54
136.
137.
  FIXED
  ACCEL
138.
139.
  P014
140.
141
                       53 AMT=0.
  P014
P014
                               AMR=0.
                       54 CONTINUE
AVT = CODAE/M
AVD = TSBAE/M
AVA = (-TSDAE + DBSA - DRAGA)/M
V
SKIP ON VERTICAL RISE OR PITCHOVER
IF(JGII ED.8) GO TO 103
   PO14
ACCEL
ACCEL
ACCEL
COMN
142.
143.
144
145.
146.
                C
   103-
  ACCEL
```

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# SUBRØUTINE ADEQ3A

#### Subroutine ADEQ3A

### Entry Point, ADEQ

#### Purpose

ADEQ3A computes the derivatives of the adjoint differential equations as expressed in equations (12.3-3) through (12.3-8) in Volume I. It also supplies the integrands of the upper triangular portion of the A matrix as given in equation (12.1-20). These, of course, contain functions of the impulse response function as defined in equation (11.1-16).

## Description

This routine is called from BNTG.

| FORTRAN | MATH   | CODE | DESCRIPTION                                                 | STORA      |      | SUBROUTIN                                                                             |                                 |
|---------|--------|------|-------------------------------------------------------------|------------|------|---------------------------------------------------------------------------------------|---------------------------------|
| SYMBOL  | SYMBOL |      | DECORT: 110W                                                | BLOCK      | LOC  | SUBR LUD                                                                              | E VAR                           |
| A       | A      | 0    | Control Integral matrix                                     | /GENF /(   | 109) | ADEQ3A O<br>ADICB3 M<br>BGET3 O<br>BNIG I<br>BST03 I<br>MTX3A I<br>PAYO2 I<br>TRAN3 I | A<br>A<br>A<br>A<br>A<br>A<br>A |
| DVARL   |        | 0    | Array of derivatives for adjoint integration                | /\$TATE3/( | 128) | ADEQ3A O<br>ADIC3A O<br>ADIC3A I                                                      | DVARL<br>DVARL<br>DVARL<br>DY   |
| GDA     | ∂7/∂∝  | I    | See symbol                                                  | /AEC03 /(  | 5)   | ACCEL 0<br>ADEQ3A I                                                                   | GDA<br>GDA                      |
| GDG     |        | I    | Partial derivative of equation of motion WRT state          | /STATE3/(  | 729) | ADEQ3A I<br>PDY3A D                                                                   | 606<br>606                      |
| GDM     |        | 1    | Partial derivative of equation of motion WRT state          | /STATE3/(  | 741) | ADEQ3A I<br>PDY3A D                                                                   | 60M<br>60M                      |
| GDO     |        | I    | Partial derivative of equation of motion WAT state          | /STATE3/(  | 750) | ADEO3A I<br>PDY3A O                                                                   | 600<br>600                      |
| GDP     |        | 1    | Partial derivative of equation of motion WRT state          | /STATE3/(  | 745) | ADEQ3A I<br>PDY3A O                                                                   | GDP<br>GDP                      |
| GDPH    | a7/a4  | I    | See symbol                                                  | /AEC03 /(  | 14)  | ACCEL 0<br>ADEQ3A I<br>PDY3A 0                                                        | GOPH<br>GDPH<br>GDPH            |
| GDR     |        | I    | Partial derivative of equation of motion WRT state          | /STATE3/(  | 735) | ADEQ3A I<br>PDY3A 0                                                                   | GDR<br>GDR                      |
| GDV     |        | 1    | Partial derivative of equation of motion WRT state          | /STATE3/(  | 722) | ADEQ3A I<br>PDY3A O                                                                   | 6DV                             |
| HTDR    |        | I    | Partial derivative of equation of motion WRT state          | /STATE3/(  | 754) | ADEQ3A I<br>PDY3A D                                                                   | HTOR<br>HTOR                    |
| VOTH    |        | I    | Partial derivative of equation of motion WRT state          | /STATE3/(  | 753) | ADEO3A I<br>PDY3A O                                                                   | HTDV<br>HTDV                    |
| LB      |        | I    | First element number in partitioned d¥ vector               | /XCODES/(  | 180) | ADEQ3A I<br>ADICB3 O<br>ADIC3A M                                                      | LB<br>LB<br>NN                  |
| MB      |        | 1    | Last element number in partitioned d¥ vector                | /XCODES/(  | 181) | ADEQ3A I<br>ADICB3 O<br>ADIC3A O                                                      | MB<br>MB<br>MB                  |
| MOM     |        | I    | Partial derivative of equation of motion WAT state          | /STATE3/(  | 742) | ADEQ3A I<br>PDY3A D                                                                   | MDM<br>MDM                      |
| MOR     |        | I    | Partial derivative of equation of motion WAT state          | /STATE3/(  | 736) | ADEQ3A I<br>PDY3A O                                                                   | MOR<br>MOR                      |
| MOV     |        | I    | Partial derivative of equation of motion WRT state          | /STATE3/(  | 724) | ADEQ3A I<br>PDY3A D                                                                   | MDV                             |
| NB      |        | I    | Extent of integration set during adjoints on branch problem | /XCODES/(  | 179) | ADEQ3A I<br>ADICB3 M<br>ADIC3A M<br>BNTG O<br>RKTB3A I<br>STVRL3 I                    | NB<br>NB<br>NB<br>NB<br>NB      |

| ORTHAN<br>Symbol | MAIH<br>Symbol | CODE      | DESCRIPTION                                        | STORA;<br>Bluck | STORAGE<br>BLOCK LOC |                                                                                                                           | E USASE<br>VAR                                               |
|------------------|----------------|-----------|----------------------------------------------------|-----------------|----------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
|                  |                | - <u></u> |                                                    |                 |                      | SUBR CODE                                                                                                                 |                                                              |
| NCN              |                | Ī         | Number of elements in d <b>Ÿ</b>                   | /XC0DES/(       | 160)                 | ADED3A I<br>ADIC83 I<br>ADIC3A I<br>ADIUST I<br>AST3 BNTG I<br>BST03 I<br>MTX3A I<br>OUT I<br>TEST M<br>TOPM I<br>TRANS I | NCCH<br>NCCH<br>NCCH<br>NCCH<br>NCCH<br>NCCH<br>NCCH<br>NCCH |
| 006              |                | 1         | Partial derivative of equation of motion WRT state | /STATE3/(       | 732)                 | ADEQ3A I<br>PDY3A D                                                                                                       | 006<br>006                                                   |
| ODP              |                | 1         | Partial derivative of equation of motion WRT state | /STATE3/(       | 747)                 | ADEQ3A I<br>PDY3A 0                                                                                                       | ODP<br>ODP                                                   |
| ODR              |                | I         | Partial derivative of equation of motion WRT state | /STATE3/(       | 738)                 | ADEQ3A I<br>PDY3A 0                                                                                                       | ODR<br>ODR                                                   |
| 004              |                | 1         | Partial derivative of equation of motion WAT state | /STATE3/(       | 726)                 | ADEQ3A I<br>PDY3A M                                                                                                       | ODV<br>ODV                                                   |
| PDA              | ∂•1/∂∝         | I         | See symbol                                         | /AEC03 /(       | 6)                   | ACCEL 0<br>ADE03A I                                                                                                       | PDA<br>PDA                                                   |
| PDG              |                | I         | Partial derivative of equation of motion WRT state | /STATE3/(       | 731)                 | ADEQ3A I<br>PDY3A O                                                                                                       | PD6<br>PD6                                                   |
| PBM              |                | I         | Partial derivative of equation of motion WRT state | /STATE3/(       | 743)                 | ADEQ3A I<br>PDY3A O                                                                                                       | P D M<br>P D M                                               |
| P D O            |                | I         | Partial derivative of equation of motion WRT state | /STATE3/(       | 751)                 | ADEQ3A I<br>PDY3A O                                                                                                       | P 0 0<br>P 0 0                                               |
| PDP              |                | I         | Partial derivative of equation of motion WRT state | /STATE3/(       | 746)                 | ADEQ3A I<br>PDY3A O                                                                                                       | PDP<br>PDP                                                   |
| PDPH             | ð <b>•</b> ∕∂¢ | 1         | See symbol                                         | /AEC03 /(       | 15)                  | ACCEL D<br>ADEO3A I<br>PDY3A D                                                                                            | POP#<br>POP#<br>POP#                                         |
| PDR              |                | I         | Partial derivative of equation of motion WRT state | /STATE3/(       | 737)                 | ADEQ3A I<br>PDY3A 0                                                                                                       | PDR<br>PDR                                                   |
| POV              |                | I         | Partial derivative of equation of motion WRT state | /STATE3/(       | 725)                 | ADEQ3A 1<br>PDY3A 0                                                                                                       | PDV<br>PDV                                                   |
| RDG              |                | 1         | Partial derivative of equation of motion WRT state | /STATE3/(       | 730)                 | ADEQ3A I<br>PDY3A O                                                                                                       | RDS                                                          |
| RDV              |                | I         | Partial derivative of equation of motion WRT state | /STATE3/(       | 723)                 | ADEQ3A I<br>PDY3A O                                                                                                       | RDV<br>RDV                                                   |
| กอด              |                | 1         | Partial derivative of equation of motion WRT state | /STATE3/(       | 733)                 | ADEQ3A I<br>PDY3A O                                                                                                       | 006<br>000                                                   |
| 900              |                | 1         | Partial derivative of equation of motion WRT state | /STATE3/(       | 752)                 | ADEQ3A I<br>PDY3A D                                                                                                       | UDO<br>UDO                                                   |
| UÐP              |                | I         | Partial derivative of equotion of motion WRT state | /STATE3/(       | 748)                 | ADEQ3A I<br>PDY3A O                                                                                                       | UDP<br>UDP                                                   |
| UOR              |                | I         | Partial derivative of equation of motion WRT state | /5TATE3/(       | 739)                 | ADEQ3A I<br>PDY3A M                                                                                                       | UDR<br>UDR                                                   |
| אסט              |                | 1         | Partial derivative of equation of notion WRT state | /STATE3/(       | 727)                 | ADEQ3A I<br>PDY3A M                                                                                                       | UDV                                                          |
| VARL             |                | 1         | Array of variables for adjoint integration         | /STATE3/(       | 29)                  | ADEQ3A I<br>ADICB3 D<br>ADIC3A D<br>PROPIN I<br>RKTA3A M<br>RKTB3A M<br>STVRL3 D<br>TRAN3 M                               | VARL<br>VARL<br>VARL<br>ZZ<br>F<br>VARL<br>VARL              |

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| SYMBOL       | MATH<br>Symhol                            | CODE DESCRIPTION                                                          | STORA:    | SE<br>'LOC | SUBBROUTINE USAGE<br>SUBB CODE VAR                                                                                                   |
|--------------|-------------------------------------------|---------------------------------------------------------------------------|-----------|------------|--------------------------------------------------------------------------------------------------------------------------------------|
| VDA          | aÿ/a∝                                     | 1 See symbol                                                              | /AEC03 /( | 4)         | ACCEL O VOA                                                                                                                          |
| VDG          | 9 y / 8 x                                 | I Partial derivative of equation of motion WRT state                      | /STATE3/( | 728)       | ADEQ3A I VDA<br>ADEQ3A I VDG<br>PDY3A O VDG                                                                                          |
| MGV          |                                           | 1 Partial derivative of equation of motion WAT state                      | /STATE3/( | 740)       | ADEQ3A I VDM<br>PDY3A 8 VDM                                                                                                          |
| V00          |                                           | I Partial derivative of equation of motion WRT state                      | /STATE3/( | 749)       | ADEQ3A 1 VDO<br>PDY3A 0 VDO                                                                                                          |
| VDP          |                                           | I Partial derivative of equation of motion WRT state                      | /STATE3/( |            | ADEQ3A I VDP<br>PDY3A O VDP                                                                                                          |
| VOR          |                                           | I Partial derivative of equation of motion WRT state                      | /STATE3/( |            | ADEQ3A I VDR<br>PDY3A O VDR                                                                                                          |
| VOV          |                                           | I Partial derivative of equation of motion WAT state                      | /STATE3/( |            | ADEGSA I VBV<br>PBYSA B VDV                                                                                                          |
| ₩ <b>DRK</b> |                                           | I Working array, contains TOPEN1, TOPEN2, and PHIWT                       | /STS /(   | 37         | ADEQ3A I WORK FNTG I WORK MODELB D WORK MTX3A I WORK SDINP M WORK TEST M WORK                                                        |
| XL.          | $\gamma_{ar{f 4}^{f 1}f U}$ 1             | គ Matrix of adjoint <b>variables</b>                                      | /STATE3/( | 246)       | ADEQ3A M XL ADIC3A M XL ADIC3A M XL ADID3A M XL AST3 M XL BGET3 U XL BST03 I XL MTX3A I XL UUT I XL STAU M XL STVRL3 I XL TRAN3 M XL |
| XLAMA        | $V_{\tilde{\mathbb{A}}^1 \mathfrak{Q}^1}$ | M Impulse response function column vector associated with angle of attack | /AEC03 /( | 16)        | ADEQ3A M XLAMA ADIC3A D XLAMA AST3 D XLAMA BGET3 D XLAMA BST03 M XLAMA MTX3A I XLAMA TRAN3 M XLAMA                                   |
| XLAMP        | $\mathbb{V}_{\mathbb{A}^1 \mathbb{U}^1}$  | M Impulse response function column vector associated with bank angle      | /AECO3 /( | 25)        | ADEQ3A M XLAMP<br>ADIC3A O XLAMP<br>AST3 O XLAMP<br>BGET3 O XLAMP<br>BST03 M XLAMP<br>MTX3A I XLAMP<br>TRAN3 M XLAMP                 |

| c | 63                                                                                       | NE ADEQSA<br>MPUTE DER                                         | IVATIVES OF                                                     | ADJOINT BIT                                                       | FFERENTIAL                                                                   | EQUATIONS                                                        | A0<br>C0                                 |
|---|------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------|
| C | AL<br>An                                                                                 |                                                                | RESPONSE<br>DS OF CONTR                                         |                                                                   | LS (A MAT                                                                    | 6141                                                             | CO                                       |
| • |                                                                                          |                                                                |                                                                 |                                                                   |                                                                              |                                                                  | ŠŤ                                       |
|   | *DPAY                                                                                    | PMIN                                                           | , WORK (26)<br>2) , AR(260),                                    | . NWOS                                                            | .IPC (                                                                       | 7), NITER                                                        | , ŠŤ                                     |
|   | ≠MNGA(20,                                                                                | 2) MNGP(20,                                                    | 2),AR(200),                                                     | 1AB(2G) , IN                                                      | P(20),15¥C                                                                   | 20)                                                              | 51                                       |
|   | COMMON/S                                                                                 | TATE3/                                                         |                                                                 |                                                                   |                                                                              | £.544.3.7.3                                                      | ST                                       |
|   |                                                                                          | 1,0440                                                         | 1 JAC / 20 01                                                   |                                                                   | ,SINGAP                                                                      | ,544(10)<br>,5AVBP(15)                                           | , 5T                                     |
|   | *XL(9,9)<br>*SINPSI                                                                      |                                                                |                                                                 | , casana                                                          | OCORHO                                                                       | ,acara2                                                          |                                          |
|   | "CHOW /                                                                                  | 9),OMEGA                                                       |                                                                 |                                                                   |                                                                              |                                                                  | , 31<br>5T                               |
|   | +YDV                                                                                     | , SDV                                                          | RNV                                                             | HBY                                                               | ,POY                                                                         | , ODV                                                            | , ST                                     |
|   | *UDV                                                                                     | , VD6                                                          |                                                                 | anc                                                               | PNG                                                                          | .006                                                             | , ST                                     |
|   | +UDG<br>+UDR                                                                             | , VDR                                                          | GOR<br>GDM                                                      | , MUH                                                             | P DR<br>P DM                                                                 | , DDR<br>, VDP                                                   | , ŞŢ                                     |
|   | +GDP                                                                                     | , SDV<br>, VDG<br>, VDR<br>, VDM<br>, PDP                      | ODP                                                             | , upp                                                             | , V00                                                                        | 600                                                              | , ST                                     |
|   | *PDD                                                                                     |                                                                | ,HTDV                                                           | HTOR                                                              | ,                                                                            | ,000                                                             | , št                                     |
|   | REAL MDM                                                                                 | , UDO<br>MDV, MDR                                              | <b>,</b>                                                        | ,                                                                 |                                                                              |                                                                  | ŠŤ                                       |
|   | COMMON/S                                                                                 | IAIE3/                                                         |                                                                 |                                                                   |                                                                              |                                                                  | ŞT                                       |
|   | *SIN2RO<br>COMMON/A                                                                      | COSERO                                                         | ,C0526#                                                         |                                                                   |                                                                              |                                                                  | ŞŢ                                       |
|   | *APHO                                                                                    | ADUD                                                           | , ALPHA                                                         | , VDA                                                             | ,GDA<br>,PHI                                                                 | PDA                                                              | , AE                                     |
|   | *SINA                                                                                    |                                                                | .PHIO                                                           | ,PHID                                                             | PHI                                                                          | 'SINPHI                                                          | , AE                                     |
|   | *COSPHI                                                                                  |                                                                |                                                                 | XLAMA(9)                                                          |                                                                              | SINPHI<br>CBO                                                    | , AE                                     |
|   | +CD0M                                                                                    |                                                                | .FK                                                             | - XCBB                                                            | .ZCSM                                                                        |                                                                  | , AE                                     |
|   | *CM                                                                                      | 1: MB                                                          | , LANA , LAY                                                    | 1.741)                                                            | CMOM                                                                         | FKM                                                              | , AE                                     |
|   | ÷CLAM<br>≠CD                                                                             | CL<br>CDA                                                      | , CLA<br>, CDM                                                  | CLM                                                               | ,                                                                            |                                                                  | AE<br>AE                                 |
|   | COMMON /                                                                                 | XCÓDES/                                                        | ,                                                               |                                                                   |                                                                              |                                                                  | ΧČ                                       |
|   | #1TQ (                                                                                   | 91 1000 12                                                     | 0),171                                                          | INTE                                                              | .J610(20.                                                                    | 2), JFH (26,2                                                    | ), XC                                    |
|   | # ICT / 3                                                                                | A 1                                                            | NCMST                                                           | MS R                                                              | MSAR                                                                         | มเกมอ                                                            | , XC                                     |
|   | *120P                                                                                    |                                                                |                                                                 | , IF AN                                                           | _IFB                                                                         | LIND                                                             | , XC                                     |
|   | +10PEN<br>≠ITCT                                                                          |                                                                | ISPH                                                            | ,1551                                                             | , LARC                                                                       | , ISTART                                                         | , XC                                     |
|   | *KOP                                                                                     | , ITER<br>, KPST                                               | IVAR<br>K<br>NEQ                                                | JK<br>JK<br>KST                                                   | JPS<br>,NAD                                                                  | NCASE                                                            |                                          |
|   | +NCN                                                                                     | NEQB                                                           | ÑEO                                                             | , NOP                                                             |                                                                              |                                                                  | , xc                                     |
|   | *NST                                                                                     | , NEQB<br>, IPST                                               |                                                                 |                                                                   |                                                                              |                                                                  | , XC                                     |
|   | *IPHNB                                                                                   | ,IBLK1                                                         | ,IBLK2                                                          | ,istor                                                            | ISTPP                                                                        | , L                                                              | , XC                                     |
|   | ⊁IFOB<br>⊁NCTIN                                                                          | NB<br>NCOC TI                                                  | , IBLK2<br>LB<br>AB(8), JPRP, J                                 | CLI MIL MOST                                                      | ,MPHP                                                                        | , MPH6                                                           | , XC                                     |
|   | COMMONAC                                                                                 | ENE/                                                           | MDC 0 J, JFMF, J                                                | 011, 711, AF 11                                                   | 11201,381,                                                                   | JFZ,JF3                                                          | SE                                       |
|   | +DMG(20)                                                                                 | ,0MGP(20,<br>,ACON(9)                                          | 2), VARQ(9)                                                     | ,TOL(9)<br>,COT1(9,9)                                             | ,SVAR(10)                                                                    | , WDC(20)                                                        | , ĜĒ                                     |
|   | *A(9,9)                                                                                  | , ACON(9)                                                      | , BCON(9)                                                       | ,COT1(9,9)                                                        | ,DCON(9)                                                                     | OTP                                                              | , GE                                     |
|   | *DT\$`<br>*R                                                                             | ,01                                                            | S                                                               | , , , , ,                                                         |                                                                              | , os                                                             | , SE                                     |
|   | + v Niii                                                                                 | ,RE<br>,PAR                                                    | MACH<br>ROR                                                     | ,PA<br>,CSR                                                       | , RO<br>, YNR                                                                | , CS                                                             | , GE                                     |
|   | *SVSQ                                                                                    | TIMEPH                                                         | TIMES                                                           |                                                                   | ŢŌŜ                                                                          | , SUMSQ<br>, TR(9)                                               |                                          |
|   | *T5T(20)                                                                                 |                                                                | V1.U15(201                                                      | BIP(20)                                                           | . 1                                                                          | , W                                                              | , aE                                     |
|   | *TLP1(20)                                                                                | T151 (7                                                        | 01 NTP1(20)                                                     | ,BIP(20)<br>,DIS1(20)<br>,TAX                                     | , 11 ME                                                                      |                                                                  | 8E                                       |
|   | ≠TIMPR<br>+AE                                                                            | LIFT<br>FP                                                     | DRAS                                                            | , I A X                                                           | TBURN                                                                        | . IB!H ZO I                                                      | , <u>6</u> E                             |
|   | *QR                                                                                      |                                                                | FPOLD<br>FVAC                                                   | ,FPD<br>,LIFTV                                                    | MACHR                                                                        | MACHY                                                            | , GE<br>SE                               |
|   | *LIFTR                                                                                   | . 1.15 19                                                      |                                                                 | RRAGY                                                             | DRAGR                                                                        | . ORAGA                                                          | , GE                                     |
|   | *                                                                                        | LIFTH                                                          | OBR                                                             | na                                                                | TCP                                                                          | ORAGA<br>ISPF                                                    | , GE                                     |
|   |                                                                                          | N 0 011                                                        | ULFT                                                            | 1111 1 1 1 1 1                                                    | .ULFTR                                                                       | LULFIA                                                           | , GE                                     |
|   | *                                                                                        |                                                                | . XACGR                                                         |                                                                   | .XACSH                                                                       | , CODAE<br>, SID                                                 | , SE                                     |
|   | *XMCG                                                                                    | , XMCGV                                                        | CALDUA                                                          |                                                                   |                                                                              | 2111                                                             | , 6E                                     |
|   | *XMCG<br>*CULFT                                                                          | , CT<br>SIDAE                                                  | CALPHA                                                          | .CUE                                                              | DELTAE                                                                       | ,                                                                | C.E.                                     |
|   | *XMCG                                                                                    | SENE /                                                         | , XCG                                                           | ,ZCG                                                              | , X,3                                                                        |                                                                  | SE<br>SE                                 |
|   | *XMCG<br>*CULFT<br>*COD<br>COMMON /<br>*XJV                                              | SENE /                                                         | , CALPHA<br>, XCG                                               | ,ZCG                                                              | , X,3                                                                        |                                                                  | ĞΕ                                       |
|   | *XMCG<br>*CULFT<br>*CGD<br>COMMON /<br>*XJV<br>*FRATED                                   | SIDAE<br>SENF /<br>XJR                                         | , CALPHA<br>, XCG                                               | ,ZCG<br>,GAMMAD                                                   | , XKE                                                                        | , XKP                                                            | , 6E<br>6E                               |
|   | *XMCG<br>*CULFT<br>*COD<br>COMMON /<br>*XJV<br>*FRATED<br>*P1                            | SIDAE<br>SENF /<br>XJR<br>, IRATED                             | ,CALPHA<br>,XCS<br>,GH                                          | ,ZCG<br>,SAMMAD                                                   | , X, S<br>, XK S                                                             | , XKP                                                            | , 6E<br>, 6E                             |
|   | *XMCG<br>*CULFT<br>*COD<br>COMMON /<br>*XJV<br>*FRATED<br>*P1<br>*XK1T                   | SIDAE<br>SENF /<br>XJR<br>, IRATED<br>, P2<br>, XK2T<br>, XK2T | , CALPHA<br>, XCG<br>, GH<br>, P3<br>, XK3T                     | ,ZCG<br>,GAMMAD<br>,XK1<br>,XK1D                                  | , XK6<br>, XK2<br>, XK2                                                      | , XKP<br>, XK3<br>, XK3D                                         | , 6E<br>, 6E<br>, 6E                     |
|   | *XMCG<br>+CULFT<br>+COD<br>COMMON /<br>*XJV<br>+FRATED<br>+P1<br>*XKIT<br>*XKIA          | SIDAE<br>SENF /<br>XJR<br>, IRATED<br>, P2<br>, XK2T<br>, XK2T | , CALPHA<br>, XCG<br>, GH<br>, P3<br>, XK3T<br>, XK3A<br>, XK3A | ,ZCG<br>,GAMMAD<br>,XK1<br>,XK1D                                  | , XK6<br>, XK2<br>, XK2D<br>, XK2V<br>, XK2V                                 | , XKP<br>, XK3<br>, XK3D<br>, XK3V                               | . SE<br>. SE<br>. SE<br>. SE             |
|   | *XMCG<br>+CULFT<br>*COD<br>COMMON /<br>*XJY<br>+FRATED<br>*P1<br>*XK1T<br>*XK1A<br>*XK1A | SIDAE<br>SEMF /<br>XJR<br>IRATED<br>P2<br>XK2T<br>XK2A<br>XK2G | , CALPHA<br>, XCG<br>, GH<br>, P3<br>, XK3T<br>, XK3A<br>, XK3G | , CDE<br>, ZGG<br>, SAMMAD<br>, XK1<br>, XK1D<br>, XK1V<br>, XK1P | , XX 6<br>, XX 2<br>, XX 2 0<br>, XX 2 V<br>, XX 2 P<br>, XX 2 0             | , XKP<br>, XK3<br>, XK3D<br>, XK3V<br>, XK3P                     | 6E 6 |
|   | *XMCG<br>+CULFT<br>*COD<br>COMMON /<br>*XJY<br>+FRATED<br>*P1<br>*XK1T<br>*XK1A<br>*XK1A | SIDAE<br>SEMF /<br>XJR<br>IRATED<br>P2<br>XK2T<br>XK2A<br>XK2G | , CALPHA<br>, XCG<br>, GH<br>, P3<br>, XK3T<br>, XK3A<br>, XK3G | , CDE<br>, ZGG<br>, SAMMAD<br>, XK1<br>, XK1D<br>, XK1V<br>, XK1P | , XK 6<br>, XK 2<br>, XK 2 D<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P | , XKP<br>, XK3<br>, XK3D<br>, XK3V<br>, XK3P<br>, XK3O<br>, XK3M | GE 6E 6E 6E 6E 6E 6E                     |
|   | *XMCG<br>+CULFT<br>*COD<br>COMMON /<br>*XJY<br>+FRATED<br>*P1<br>*XK1T<br>*XK1A<br>*XK1S | SIDAE<br>SEMF /<br>XJR<br>IRATED<br>P2<br>XK2T<br>XK2A<br>XK2G | , CALPHA<br>, XCG<br>, GH<br>, P3<br>, XK3T<br>, XK3A<br>, XK3G | , CDE<br>, ZGG<br>, SAMMAD<br>, XK1<br>, XK1D<br>, XK1V<br>, XK1P | , XK 6<br>, XK 2<br>, XK 2 D<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P | , XKP<br>, XK3<br>, XK3D<br>, XK3V<br>, XK3P<br>, XK3O<br>, XK3M | GEE GEE GEE GEE GEE GEE                  |
|   | *XMCG<br>+CULFT<br>*COD<br>COMMON /<br>*XJY<br>+FRATED<br>*P1<br>*XK1T<br>*XK1A<br>*XK1S | SIDAE<br>SEMF /<br>XJR<br>IRATED<br>P2<br>XK2T<br>XK2A<br>XK2G | , CALPHA<br>, XCG<br>, GH<br>, P3<br>, XK3T<br>, XK3A<br>, XK3G | , CDE<br>, ZGG<br>, SAMMAD<br>, XK1<br>, XK1D<br>, XK1V<br>, XK1P | , XK 6<br>, XK 2<br>, XK 2 D<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P | , XKP<br>, XK3<br>, XK3D<br>, XK3V<br>, XK3P                     | GEEGE GEEGE                              |
|   | *XMCG<br>+CULFT<br>*COD<br>COMMON /<br>*XJY<br>+FRATED<br>*P1<br>*XK1T<br>*XK1A<br>*XK1S | SIDAE<br>SEMF /<br>XJR<br>IRATED<br>P2<br>XK2T<br>XK2A<br>XK2G | , CALPHA<br>, XCG<br>, GH<br>, P3<br>, XK3T<br>, XK3A<br>, XK3G | , CDE<br>, ZGG<br>, SAMMAD<br>, XK1<br>, XK1D<br>, XK1V<br>, XK1P | , XK 6<br>, XK 2<br>, XK 2 D<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P | , XKP<br>, XK3<br>, XK3D<br>, XK3V<br>, XK3P<br>, XK3O<br>, XK3M | GEEGE GEEGE                              |
|   | *XMCG<br>+CULFT<br>*COD<br>COMMON /<br>*XJY<br>+FRATED<br>*P1<br>*XK1T<br>*XK1A<br>*XK1S | SIDAE<br>SEMF /<br>XJR<br>IRATED<br>P2<br>XK2T<br>XK2A<br>XK2G | , CALPHA<br>, XCG<br>, GH<br>, P3<br>, XK3T<br>, XK3A<br>, XK3A | , CDE<br>, ZGG<br>, SAMMAD<br>, XK1<br>, XK1D<br>, XK1V<br>, XK1P | , XK 6<br>, XK 2<br>, XK 2 D<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P<br>, XK 2 P | , XKP<br>, XK3<br>, XK3D<br>, XK3V<br>, XK3P<br>, XK3O<br>, XK3M | GEEGE GEEGE                              |

20 BCT 72 6 01-46

```
I SET RANGE OF INTEGRATION ARRAY

JJ=NB

II=NB-1

II STURE ADJOINT DERIV. IN INTEGRATION ARRAY

DO 20 I=LB, MB

DO 10 J=1,5

XL(J, I)=VARL(IJ)

OVARL(II+1)= -( XL(1, I)*VDV* XL(2, I)*GBV* XL(3, I)*RDV*XL(4, I)*

ADE03A

DVARL(II+1)= -( XL(1, I)*VDV* XL(2, I)*GBV* XL(3, I)*RDV*XL(4, I)*

DVARL(II+2)= -( XL(1, I)*VDV* XL(2, I)*GBV* XL(3, I)*RDG*XL(5, I)**

DVARL(II+3)= -( XL(1, I)*VDF* XL(2, I)*GDG* XL(3, I)*RDG*XL(5, I)**

DVARL(II+4)= -( XL(1, I)*VDF* XL(2, I)*GDR* XL(4, I)*MDR*XL(5, I)**

DVARL(II+4)= -( XL(1, I)*VDF* XL(2, I)*GDF*XL(5, I)*MDR*XL(5, I)*PDP*

DVARL(II+5)= -( XL(1, I)*VDF* XL(2, I)*GDF*XL(5, I)*PDP*XL(6, I)**

DVARL(II+6)= -( XL(1, I)*VDF*XL(2, I)*GDF*XL(5, I)*PDA*

XLAMA(I)= -( XL(1, I)*VDF*XL(2, I)*GDF*XL(5, I)*PDA*

ADE03A

ADE03A

DU 1I=II+6

III-A MARRIX INTEGRANDS

DU 4D MI=I, NCN

NI = MI

C=1.

IV SET BRANCH CONSTRAINT ELEMENTS TO ZERO AS APPROPRIATE

DU 3D MJ=1,NI

AME03A

ADE03A

ADE
  COMN
ADEQ3A
ADEQ3A
COMN
ABEQ3A
ADEQ3A
                  100
100
101
102
103. C
104.
105.
106.
107.
108.
110.
111.
113.
114.
115.
116.
```

20 DCT 72 6.01-46

# SUBRØUTINE ADICB3

#### Subroutine ADICB3

### Purpose

This subroutine performs calculations of adjoint discontinuities and initializations for branched and intermediate constraint problems. It contains 3 entry points, ADI3B, ADICB, and ADI2B. These entry points are explained below with cross reference to equations in Volume I and Roman numeral comments in the subroutine listing.

#### Description

- I Branch point approached from Branch 3. (Entry ADI3B)
- I-A Save A matrix at this corner point to permit restoration of complete matrix on trunk.
- I-B Reset time and state to end of branch. This will permit initiation of adjoint integration from end of branch 2.
- II Adjoint initial conditions are calculated to initiate Branch 2 and integration. The equation for the adjoint initial condition is (11 5-2).
- . IV At intermediate arc constraint (ENTRY ADICB)

  This entry point sets up necessary data for initializing adjoints at end of intermediate constraint arc. Logic then proceeds to II and III where the initialization equation corresponding to (11.4-3) is computed.

The entry point in this routine is called from BNTG.

| FORTRAN<br>SYMBOL | MATH<br>Symbol | CODE           | DESCRIPTION                                   | STORAG<br>Block | E<br>LDC | SUBR CODE                                                                                                                                                 | USAGE<br>Var                           |
|-------------------|----------------|----------------|-----------------------------------------------|-----------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| A                 | A              | M Contr        | ol integral matrix                            | /GENF /(        | 109)     | ADEQ3A Q A ADICB3 M A BGET3 D A BST03 I A MTX3A I A PAY02 I A SDINP I A TRAN3 I A                                                                         |                                        |
| COTI              |                | м Тетр         | storage for a matrix also called B matrix     | /GENF /(        | 208)     | MTX3A M B                                                                                                                                                 | 0T1                                    |
| DFD               | ¥              | W Rate         | of change of constraint                       | /401CB3/(*      | )        | ADICB3 ₩ B                                                                                                                                                | FO                                     |
| DVAR              | ÿ              | m State        | vector derivatives in steepest descent module | /STATE3/(       | 15)      | ADIC3A I D<br>ADID3A M D<br>DER3A O V<br>DTF3 I V<br>ENVPRM I D<br>PROPIN D D<br>REU3 I D<br>RKTA3A I D<br>STP3 I D                                       | VAR<br>VAR<br>VAR                      |
| DVARL             |                | 0 Array        | of derivatives for adjoint integration        | /\$TATE3/(      | 128)     | ADICB3 0 D                                                                                                                                                | VARL<br>VARL<br>VARL                   |
| IARC              |                | I Arc n        | umber                                         | /XCODES/(       | 146)     | ADID3A I I ADJUST I I AST3 I I I BNTG M I ENVPRM I I FNTG M I GETIT I I MODELA I I PROPB I I PROPIN I I REU3 I I SDINP M I STAU I I STAU I I I STAU I I I | ARCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC |
| ISKP              |                | W Flag<br>PDBC | to stop redundant computation in subroutine   | /ADICB3/(*      | )        | ADICB3 W I                                                                                                                                                | SKP                                    |
| 110               |                | I Const        | craint option code (internal)                 | /XCDDES/(       | 1)       | ADIC3A I I<br>ADID3A I I<br>CON3 I I<br>SDINP M I<br>STAU I I                                                                                             | TQ<br>TQ<br>TQ<br>TQ<br>TQ<br>TQ       |
| 12                |                | M Absol        | ute value of arc cut-off option code          | /xcodes/(       | 153)     | BNTG M J<br>FNTG M J<br>PROPB I J<br>PROPIN I J<br>STP3 I J                                                                                               | \$<br> \$<br> \$                       |

| IOHIRAN<br>SYMBOL | MATH<br>Symbol | CODE | DESCRIPTION                                                                      | STORA<br>BLOCK | JF<br>LOC | SUBROUTINE<br>SUBR CODE                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------|----------------|------|----------------------------------------------------------------------------------|----------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3111101           | 3111004        | ·-·· |                                                                                  | 0.064          | LUC       | 300H CODE                                                                                                                                                          | YMD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| TZL               |                | I    | Arc cut-off option flag                                                          | /XCODES/(      | 112)      | BNTG I<br>FNTG I                                                                                                                                                   | 121<br>121<br>131<br>131                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| LB                |                | 0    | First element number in partitioned d♥ vector                                    | /XCODES/(      | 180)      | ADICB3 0                                                                                                                                                           | LB<br>LB<br>NN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| MВ                |                | 0    | Last element number in partitioned d¥ vector                                     | /xcodes/(      | 181)      | ADICB3 0                                                                                                                                                           | MB<br>MB<br>MB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| NB                |                | M    | Extent of integration set during adjoints on branch problem                      | /xcobes/(      | 179)      | ADICB3 M<br>ADIC3A M<br>BNTG O<br>RKTB3A I                                                                                                                         | NB<br>NB<br>NB<br>NB<br>NB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| NCN               |                | ī    | Number of elements in d¥                                                         | /xcodes/(      | 160)      | ADICB3 I ADIC3A I ADIC3A I ADID3A I ADJUST I AST3 M BNTG I BST03 I MTX3A I OUT I PAY02 M TEST M TOPM I TRAN3 I                                                     | NCCN<br>NCCN<br>NCCON<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCCN<br>NCCN<br>NCCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NCCN<br>NC<br>NC |
| NCTIN             |                | I    | Number of elements in upper triangular portion of A                              | /xcooes/(      | 184)      |                                                                                                                                                                    | NETIN<br>NETIN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| NEQ               |                | 1    | Number of integrated states                                                      | /xcodes/(      | 162)      | ADICB3 I<br>ADIC3A I<br>ADIC3A I<br>ADIC3A I<br>AGETB3 I<br>BGET3 I<br>BST03 I<br>MTX3A I<br>OUT I<br>REU3 I<br>SDER3 I<br>SDER3 I<br>SDER3 I<br>TOPM I<br>TRAN3 I | NEQQ<br>NNEQQ<br>NNEQQ<br>NNEQQ<br>NNEQQ<br>NNEQQ<br>NNEQQ<br>NNEQQ<br>NNEQQ<br>NNEQQ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| NEQB              |                | 1    | Number of integrated quantities during adjoint solution                          | /XCODES/(      | 161)      | ADICB3 I<br>ADIC3A M                                                                                                                                               | NEOB<br>NEOB<br>NN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| NICNB             |                | 1    | Number of constraints at intermediate constraint point or at end of first branch | /XCODES/(      | , 135)    | ADICB3 I<br>ADICBA I<br>BNTG I<br>REU3 I<br>SDINP M<br>TEST I                                                                                                      | NI CNB<br>NI CNB<br>NI CNB<br>NI CNB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| NSAB              |                | Ĭ    | Number of arcs on first branch                                                   | /XC0DE5/(      | 134)      | ADICB3 I<br>BNTG I<br>ENVPRM I<br>FNTG I<br>SDINP M<br>TEST I                                                                                                      | NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| ORTRAN<br>Symbol | 741H<br>57M80L | CDOE | DESCRIPTION                                                        |          | STORAS!<br>BLOCK | LOC  | \$ 9880 9111<br>\$ 988 600                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                              |
|------------------|----------------|------|--------------------------------------------------------------------|----------|------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| NS B             |                | Ī    | Number of arcs prior to branch point or<br>intermediate constraint |          | /XCODE\$/(       | 133) | ADICB3 I<br>BNTG I<br>ENVPRM I<br>FNTG I<br>REU3 I<br>SDINP M<br>TEST I<br>TRAN3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | NS B<br>NS B<br>NS B<br>NS B<br>NS B<br>NS B<br>NS B<br>NS B |
| SFD              | Ω              | 1    | Rate of change of cut-off function                                 |          | /ADICB3/(+       | }    | ADICB3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | SFD                                                          |
| VBV              |                | I    | Saved state vector on trial trajectory                             |          | /STATE3/(        | 710) | ADICB3 J<br>REU3 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | SVBV<br>SVBV                                                 |
| 5 <b>X</b>       | aΩ/ay          | I    | Partial of cut-off WRT state                                       |          | /ADICB3/(*       | )    | ADICB3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | SX                                                           |
| TIME             | t              | 0    | Time (elapsed)                                                     |          | /GENF /(         | 493) | AOICB3 O<br>ASI3 I<br>BNIG M<br>CONS I<br>DIF3 I<br>ENVPRM I<br>EQUAS I<br>MODELA I<br>OUT I<br>PROPIN I<br>REUS M<br>RKIASA M<br>YREFS M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TIME<br>TIME<br>TIME<br>TIME<br>TIME<br>TIME<br>TIME<br>TIME |
| T <b>ST</b>      |                | I    | Array of arc end times on trial trajectory                         | [sd]     | /GENF /(         | 331) | ADICB3 1<br>BNTG 1<br>FNTG 0<br>TEST 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | TST<br>TST<br>TST<br>TST                                     |
| /AR              | •              | 0    | Relative velocity                                                  | (FT/SEC) | /STATE3/(        | 1)   | ACCEL I ADDICES OF ACCEL I ADDICES OF ACCED IN ACCEDING IN ACCE |                                                              |
| VARL             |                | 0    | Array of variables for adjoint integration                         |          | /STATE3/(        | 29)  | ADEQ3A I ADICB3 D ADIC3A D PROPIN I RKTA3A M RKTB3A M STVRL3 D TRAN3 M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Y<br>Varl                                                    |

30 OCT 72 6.01-46

| FORTHAN<br>Symbol | MATH<br>SYMBOL                     | CODE      | DESCRIPTION                           | STORA!<br>BLOCK | LOC<br>LOC | <u>5 ปลส อิป</u><br>5 ปล ล                                                                          |                            | USAGE<br>VAR                 |
|-------------------|------------------------------------|-----------|---------------------------------------|-----------------|------------|-----------------------------------------------------------------------------------------------------|----------------------------|------------------------------|
| XL                | $\lambda^{\Psi_{f i}\Omega_{f j}}$ | n matrix  | of adjoint variables                  | /STATE3/(       | 246)       | ADEQ3A<br>ADIC3A<br>ADIC3A<br>ADIC3A<br>ADIC3A<br>BGET3<br>BST03<br>MTX3A<br>GUT<br>STAUL3<br>TRAN3 | M<br>M<br>M<br>I<br>I<br>I | X                            |
| YDS               | ў г <sub>у т</sub>                 | l Array o | f state derivatives at arc end points | /5TATE3/(       | 507)       | ADICB3<br>ADID3A<br>REU3<br>Stau                                                                    |                            | Y 05<br>Y 05<br>Y 05<br>Y 05 |

```
SUBROUTINE ADICB3
THIS ROUTINE HAS THE FOLLOWING ENTRY/PURPOSE ENTRY ADI3B/1 SAVE A AT INITIAL POINT OF BRANCH 3
2 RESET STATE AND STATE DER. TO VALUE AT END OF BRANCH 2
3 SET RANGE OF INTEGRTED ADJOINTS 4 COMP ADJINITIAL COND AT END OF BRANCH 2
ENTRY ADICB/1 SETS UP NECESSARY DATA FOR INITIALIZING ADJOINTS AT END OF INTERMEDIATE CONSTRAINT ARC 2 COMPUTES ADJOINT INITIAL COND.
ENTRY ADI2B/1 RESTORES A 10 FULL SIZE AT END OF TRUNK ARC 2 RESETS RANGE OF ADJOINT INTEGRATION
   ADICB3
COMN
COMN
COMN
COMN
COMN
0000000000000
   COMN
COMN
COMN
COMN
STATE3D
  Z RESETS RANGE OF ADJOINT INTEGRATI

COMMON/STATES/
*VAR(14), DVAR (14), VARL (99), DVARL(99), YO(9)
*XL(9,9), YDP(20,9), YDS (20,9), COSGAM
*SINPSI COSPSI SINRHO, COSRHO, DCORHO
*SVBV (9), OMEGA OMEGAA
*YDV GDV ROV MOV PDV
*UDV YOR GDR MOR PDR
*UDR YOR GDR MOR PDR
*UDR YOR GDR MOR PDR
*UDR YOR GDR MOR PDR
*OPP ODP YOP YOU
*REAL MDM MOV, MOR
COMMON/STATES/
*SINZRO COSZRO COSZGM
COMMON/STATES/
*SINZRO COSZRO COSZGM
*COMMON/STATES/
*SINZRO COSZRO COSZGM
*COMMON/STATES/
*SINZRO COSZRO COSZGM
*COMMON/STATES/
*SINZRO COSZRO COSZGM
*COMMON/STATES/
*SINZRO COSZRO COSZGM
*COMMON/SENF/
*OMG(20) OMGP(20,2), VARQ(9) TOL(9) SVAR(10
*A(9,9) ACON(9) BCON(9) COTI(9,9) COON(9)
*A(9,9) ACON(9) BCON(9) COTI(9,9) TOCON(9)
*R R RE MACH PA RO
*SYSO TIMEPH TIMES TOP TOS
*TITPIC20) TILSI (20), OIPI(20) DISI(20) TIME
**TITPIC LIFT DRAG TAX TBURN
*AE FP FPOLD MAGCH
*AE FP FPOLD MAGCH
*AE IFTA DRAG TAX TBURN
**AE IFTA DRAG TAX TBURN
**AE LIFTA DRAG TAX TBURN
**
**LIFTA DRAG TAX TRUNCH
**
***LIFTA DRAG TAX TRUNCH
**
***LIFTA DRAG TAX TBURN
**
***LIFTA DRAG TAX TRUNCH
**
***LIFTA DRAG TAX TRUNCH
**
***LIFTA DRAG TAX TRUNCH
**
***CMCG XMCGM XMCG
  ,SVY(10)
,SAVBP(15)
,OCORO2
   , aby
   ,006
,008
,vdP
,GDO
   STATE3D
STATE3D
STATE3D
SENF
GENF
GENF
GENF
GENF
GENF
  WDC(20)
DTP
QS
CS
SUMSQ
TR(9)
W
DMP
TBU(20)
MACHY
   GENF
   GENF
   GENF
GENF
GENF
GENF
GENF
GENF
   DRAGS
ISP
ULFTR
XMCGM
DELTAE
   DRAGA
, ISPF
, ULFTA
, CODAE
, SID
   LIFTR
  DBR
ULFT
XMCGR
CALPHA
XCG
  , DB
, ULFTV
, XMCGA
, CDE
, ZCG
  , GAMMAD
   ,XKG
   , XKP
   XKI
XKID
XKIV
XKIP
XKID
XKIM
PR
   , XK3
, XK3D
, XK3V
, XK3P
, XK3D
, XK3D
, XK3M
, DPDY(3,8)
   , XK2
, XK2D
, XK2V
, XK2P
, XK2P
, XK2M
   GENF
   GENF
GENF
GENF
GENF
GENF
FRAT
  PO
   GENF
  SENF
XCODES
XCOD
   I BRANCH POINT APPROACHED FROM BRANCH 3 ENTRY ADI3B
   ADICB3
```

20 DCT 72 6.01-46

```
ISKP = 0

I-A SAVE A

DO 1D 1=1, NCM

DO 1D 3=1, NCM

10 COTI(J, I)=A(J, I)

I-B RESET fire AND STATE TO END OF BRANCH 2

NS = NSB + NSAB

NB = (NCM -N(CMB)** + 1

TIME = TST(NS)

DO 20 I=1, NEQ

VAR(I) = V95(I)

20 DVAR(I) = V95(I)

I-C SET RANGE OF CONSTRAINT VECTOR AND ADJOINT INTEGRATION

ARRAY

MB=NICMB

LB=1
         77780122.
8823456.
88990123.
994.
   ADICB3
COMN
ADICB3
ADICB3
COMN
ADICB3
日
   ID=1

NX = NEQB -NCTIN

II DETERMINE CUTOFF VARIABLE CODE, IF STATE, II-A,

ELSE CALC.PARTIALS
   ADI CB3
   COMN
COMN
          95
96
97
                                  30 JS = IABS(JST(N$))
IF(J5.LT.9) 60 TO 40
CALL POBC(J5,DVAR,SX,SFD,3,ISKP)
  ADICB3
ADICB3
ADICB3
  40-7
                               CALL POSC(JS,DVAR,SX,SFD,3,ISKP)

40 CONTINUE

11-A JERO ADJDINT INTEGRATION ARRAY

DO 50 1 = NB, MX

VARL(1)=0.

60 CONTINUE

III COMPUTE ADJOINT INITIAL CONDITIONS

DO 140 I=1 NICNB

DO 10 Km=1,NEQ

70 XL(KM,I)=0.

III-A DETER. CONST. CODE IF NOT TIME, III-B

ELSE SET DFD=1.,III-D

II = 110(1)

IF(11.6T.1) 60 TO 80

DFD= 1.

GO TO 110

EQUAL TO 1. AND CALC.DFD

80 IF(II.GT.10) GO TO 100
          98
   ADICB3
                          C
   COMM
  ADICB3
ADICB3
ADICB3
ADICB3
        100
        101
102.
103
104
105.
106.
                          C
   COMN
  ADICB3
ADICB3
ADICB3
COMN
       109.
110
111
112
  COMN
ADICB3
ADICB3
ADICB3
   80--
       113
114
115
   110-
   COMN
  ADICB3 16G-
ADICB3 90-
ADICB3
ADICB3
                                  80 1F(11.6T.10) GO TO 100

IF(11.EQ.10) GO TO 90

XL(11-1,1) =1.

OFD = YDS(N5,11-1)

GO TO 110
       116
117
118.
119
       120
   ADI CB3
   116
       121.
122
123
                                   90 XL(8,1)=1.
DFD='YDS(NS,8)
GD TO 110
   ADI CB3
   ADICB3
ADICB3
                               100 CALL POBC(11, DVAR, XL(1,1), DFD, 3, TSKP)
III-C CONST.15 FUNCT., COMPUTE PARTIALS AND DFD
       124
125.
  ADICB3
COMN
   COMBINE CONST. AND CUT-OFF TERMS INTO ADJOINT INITIAL CONDITIONS

IF(JS.LE.2) GO TO 140

IF(JS.GT.9) GO TO 120

XL(JS-2,1) = XL(JS-2,1) - DFD /YDS(NS,JS-2)
  ADICB3
CBMN
COMN
ADICB3
ADICB3
                             110 CONTINUE
       126
       128.
129.
130
  120
   1140
  □ 133
134
                                120 DD 130 KK=1,7
130 XL(KK,I) = XL(KK,I) - DFD/SFD *5X(KK)
  ADICB3
                               130 XL(KK,I) = XL(KK,I) - DFD/SFD *SX(KK)

140 CONTINUE
RETURN
ENTRY ADICB
IV AT INTEREDIATE ARC CONSTRAINT, SET STATE DERIV
EQUAL TO STORED NOMINAL VALUE

NS= IARC-1
DO 150 I=1, NEB
150 DVAR(I)= YDS(NS,I)
NB =1
LB=1
HB=NCM
NX = 4* NICNB
        135
   ADI CB3
  ADICB3
ADICB3
COMN
COMN
ADICB3
ADICB3
ADICB3
       136
137
138
139
140
141
142
143
```

20 BCT 72 G 01-46

```
ADICB3 30-
COMN
COMN
COMN
ADICB3
  GD TO 30
ENTRY AD126
V RESTORE A MATRIX AND ITS INTEGRAL FOR
CONTINUING BACKWARD ADJOINT SOLUTION ON TRUNK
147.
148.
149.
151.
152.
153.
154.
155.
156.
157.
158.
160.
161.
162.
163.
  C
   #ESTURE

OBTINE

MB=NCN

NX=NICNB+1

D0 160 I=NX, NCM

D0 160 J= 1, NCM

EL (I, I) = COTI(I, I)

160 A(I, I) = COTI(I, I)

NI=NEOB-HCTIN

D0 170 I=1, NCM

D0 170 J=1, I

NI=NI+1

170 VARL(NI) = A(J, I)

RETURN

END
```

20 DCT 72 G.01-46

## SUBRØUTINE ADIC3A

#### Subroutine ADIC3A

#### Purpose

Subroutine ADIC3A (entry point ADIC) computes adjoint initial conditions at the terminus of the trajectory. After zeroing out the adjoint variable matrix, the impulse response functions and the adjoint integration array (VARL and PVARL), equation (11.1-23) of Volume I is solved.

#### Description

This routine is called from TEST.

| ORTHAN | MATH   | 1006 | DESCRIPTION                                                                     | STORAGE    |      |                                                                                        |                                                |                                                                                        |
|--------|--------|------|---------------------------------------------------------------------------------|------------|------|----------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------|
| SYMBOL | SYTHOL |      | DESCRIPTION                                                                     | A LOTA     | LOC  | 503R (                                                                                 | , n o E                                        | VAR                                                                                    |
| DFD    | Ϋ́     | ω    | Rate of change of constraint                                                    | /ADIC3A/(+ | ,    | ADIC3A                                                                                 | 네                                              | DFD                                                                                    |
| DVAR   | ÿ      | I    | State vector derivatives in steepest descent module                             | /STATE3/(  | 151  | AÒID3A<br>DER3A<br>DTF3<br>ENVPRM<br>POBC<br>PROPIN<br>REU3<br>RKTA3A<br>STP3<br>YREF3 | 1<br>m<br>0<br>1<br>1<br>0<br>1<br>0<br>1<br>1 | DVAR<br>DVAR<br>DVO<br>VO<br>VO<br>VAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>VVAR |
| DVARL  |        | 0    | Array of derivatives for adjoint integration                                    | /STATE3/(  | 128) | ADEQ3A<br>ADICB3<br>ADIC3A<br>RKTB3A                                                   | 0                                              | DVARL<br>DVARL<br>DVARL<br>DY                                                          |
| INTB   |        | I    | Branching and intermediate constraint flag                                      | /XCODES/(  | 31)  | ENVPRM<br>FNTG<br>SDINP<br>TEST                                                        | I<br>I<br>M<br>I                               | INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB                           |
| ISKP   |        | М    | Flag to stop redundant computation in subroutine<br>POBC                        | /ADIC3A/(# | )    | A01C3A                                                                                 | W                                              | ISKP                                                                                   |
| ITQ    |        | 1    | Constraint option code (internaf)                                               | /XCODES/(  | 1)   | SDINP<br>Stau                                                                          | I<br>I<br>M                                    | ITO<br>ITO<br>ITO<br>ITO<br>ITO<br>ITO<br>ITO                                          |
| 1K     |        | М    | Integration routine flag tells which derivative evaluation in Runge-Kutta cycle | /XCODES/(  | 151) | MODELA                                                                                 | I<br>I<br>所                                    | 7<br>?<br>7<br>Y<br>1<br>Y                                                             |
| JS     |        | I,   | Absolute value of arc cut-off option code                                       | /XCODES/(  | 153) | FNTG<br>PROPB<br>PROPIN<br>STP3                                                        | I                                              | 15<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15                               |
| МВ     |        | ð    | Last element number in partitioned d¥ vector                                    | /XCODES/(  | 181) | ADEQ3A<br>ADICB3<br>ADIC3A                                                             | ð                                              | мв<br>Мв<br>Мв                                                                         |
| NB     |        | М    | Extent of integration set during adjoints on branch problem                     | /XCODES/(  | 179) | ADEB3A<br>ADICB3<br>ADIC3A<br>BNTG<br>RKTB3A<br>STVRL3                                 | M<br>M<br>D<br>I                               | NB<br>NB<br>NB<br>NB<br>NB<br>NB                                                       |

| SYMBOL<br>SYMBOL | MATH<br>SYMBOL      | 1000 | DESCRIPTION                                                                      | STURAGE<br>BLULK |      | SUMBOUTINE U<br>SUMB LUDE                                                                                                                                                                                                                                                       | SAGE<br>VAR                                                                                 |
|------------------|---------------------|------|----------------------------------------------------------------------------------|------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| NCN              |                     | ī    | Number of elements in d¥                                                         | /xcodes/(        | 160) | ADE 03A 1 NC<br>ADI CB3 1 NC<br>ADI CB3 1 NC<br>ADI CB3 1 NC<br>ADI UST 1 NC<br>AST3 M NC<br>BST03 1 NC<br>MTX3A 1 NC<br>MTX3A 1 NC<br>OUT 1 NC<br>PAY 02 M NC<br>TEST M NC<br>TEST M NC<br>TEST IN NC<br>TEST IN NC<br>TEST IN NC<br>TEST IN NC<br>TEST IN NC                  | N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N<br>N |
| NCTIN            |                     | M    | Number of elements in upper triangular portion of A watrix                       | /xcodes/(        | 184) |                                                                                                                                                                                                                                                                                 | TIN                                                                                         |
| NEQ              |                     | I    | Number of integrated states                                                      | /xcodes/(        | 162) | ADICB3 I NEI<br>ADICB3 I NEI<br>ADICB3 I NEI<br>ADIDB3 I NEI<br>ADIDB3 I NEI<br>BST03 I NEI<br>BST03 I NEI<br>BST03 I NEI<br>BST03 I NEI<br>BST03 I NEI<br>BST03 I NEI<br>BSDERB I NEI<br>SDERB I NEI<br>SDERB I NEI<br>SDINP M NEI<br>TOPM I NEI<br>TRANB I NEI<br>YREFB I NEI |                                                                                             |
| NEOB             |                     | M    | Number of integrated quantities during adjoint solution                          | /xcades/(        | 161) | ADICB3 I NEG<br>ADIC3A M NEG<br>RKTB3A I NN                                                                                                                                                                                                                                     | QВ                                                                                          |
| NICNB            |                     | Î    | Number of constraints at intermediate constraint point or at end of first branch | /xcodes/(        | 135) | ADIC3A I NI<br>BATS I NI<br>REU3 I NI<br>SDINP M NI<br>TEST I NI                                                                                                                                                                                                                | CNB<br>CNB<br>CNB<br>CNB<br>CNB<br>CNB                                                      |
| NN               |                     | m    | First element number in partitioned $d\Psi$ vector .                             | /xcobes/(        | 180) | ADEO3A I LB<br>ADICB3 O LB<br>ADIC3A M NN                                                                                                                                                                                                                                       | <b>,</b>                                                                                    |
| SFD,             | ù                   | 1    | Rate of change of cut-off function                                               | /AD103A/(*       | >    | ADIC3A I SF                                                                                                                                                                                                                                                                     | B                                                                                           |
| SX               | ∂Ω/ <sup>,</sup> ∂y | 1    | Partial of cut-off WRT state                                                     | /AD1C3A/(*       | )    | ADIC3A I SX                                                                                                                                                                                                                                                                     | ı                                                                                           |
| VARL             | -                   |      | Array of variables for adjoint integration                                       | /STATE3/(        | 29)  | ADECRA O VA ADICRA O VA ADICRA O VA PROPIN I ZZ RKTASA M F RKTBSA M Y STVRL3 O VA TRANS M VA                                                                                                                                                                                    | IRL                                                                                         |
| хĽ               | λ <sub>*</sub> ιΩ   | М    | Matrıx of adjoint variables                                                      | /STATE3/(        | 246) | ADEUSA M XL ADICBS M XL ADICBS M XL ADICBA M XL ADIDSA M XL ASTS M XL BSTUS I XL BSTUS I XL DUT I XL STAU M XL STVRLS I XL TRANS M XL                                                                                                                                           | • • • • • • • • • • • • • • • •                                                             |

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| FORTRAN<br>Symbol | MATH<br>Symbol                           | CODE | DESCRIPTION                                                          | * | S J O A<br>B L O U K | AGF<br>Lûc | SUBROUTIN<br>SUBR COD                                                      |                                                                      |
|-------------------|------------------------------------------|------|----------------------------------------------------------------------|---|----------------------|------------|----------------------------------------------------------------------------|----------------------------------------------------------------------|
| XLAMA             | ۱۳۰۱ کې                                  |      | npulse response function column vector associated th angle of attack |   | /AECO3 /             | ( 16)      | ADEQ3A M<br>ADIC3A O<br>AST3 O<br>BGET3 O<br>BST03 M<br>MTX3A I<br>TRAN3 M | XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA          |
| XLAMP-            | $V_{\tilde{\Lambda}^1 \tilde{\Omega}^1}$ |      | npulse response function column vector associated th bank angle      |   | /AECO3 /             | ( 25)      | ADEQ3A M<br>ADIC3A O<br>AST3 O<br>BGET3 D<br>BST03 M<br>MTX3A I<br>TRAN3 M | XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP |

```
SUBROUTINE ADICSA

COMPUTES ADJOINT INITIAL CONDITIONS AT TRAJECTORY TERMINUS

DIMENSION SX(7)
COMMON/STATES/
*VAR(14) DVAR (14) VARL (99) DVARL(99) YOU ALL(99) POPL 20,9), VDS (20,9), COSRAM SIR*
*XL(9,9) *VDPL20,9), YDS (20,9), COSRAM SIR*
*XL(9,9) *VDPL20,9), YDS (20,9), COSRAM SIR*
*XL(9,9) *VDPL20,9), YDS (20,9), COSRAM SIR*
*SINPSI COSPSI SINRHO COSRAM OCC SIRVE (99) OREGA POPL ADV (90) OREGA POPL*
*VDV GDV ROV MOR POPL*
*UDG VDR GDR MOR POPL*
*UDG VDR GDR MOR POPL*
*GDP POP OPP UDP YOU PPOD TOPP UDP YOU REAL MOM HOW, MOR POPL*
   ABIC3A
COMM
ABIC3A
STATE3D
  ABIC3A
         23456789
   C
  ,SVY(10)
,SAVBP(15)
,OCORO2
  ,YO(9)
,SINGAM
,OCORHO
   PDV
PDG
PDR
PDM
VDO
  ,00V
,00G
,00R
,VDP
,600
 10.
11.
12.
13
14
15.
16.
   STATE3D
STATE3D
AEC03
   ,COS2GM
 18.
19.
20.
21.
22.
23.
25.
   ,ALPHA
PHIO
PDPH
FK
CMAM ,CMM
CLA
,CDM
   ,VDA
,PHID
,XLAMA(9)
,XCGM
,CMO
,CLM
   ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
  ,PDA
,SINPHI
,CBG
,CLOM
,FKM
                             ABICASA
XCCODDESS
XCCODDESS
XCCODDESS
XCCODDESS
XCCODDES
XCCODES
XCCODDES
X
   ,INTB
,NSB
,IFAR
,ISST
,JK
,KST
,NOP
,ISTOP
  31
32.
 33.
34.
35.
   ,NPH
,IPHN
,ISTPP
,NPHP
   ,N
,ISTNB
 36.
37.
38.
39.
40.
41.
   ,L
,NPHB
JP2,JP3
  MΒ
  611, MTT, MPIN(20), JP1,
   TOL(9)
   ,5 VAR(10)
   , WDC( 20 )
   ,TOL(9),COTI(9,9),DPSQ,CSR,TOP,DIS1(20),TAX,FPD,FPTTAX,FPD,FPTTAX,FPD,FPTTAX,FPD,FPTTAX,FPD,FPTTAX,F
  SVAR(10)
DCON(9)
RD
VNR
TOS
TIME
TBURN
MACHR
   , DTP
, QS
, CS
, SUMSQ
, TR(9)
  GENF
4444444555555555555666666667777775
  SENF
  GENF
GENF
GENF
  ,TBU(20)
,HACHY
   DRAGR
ISP
ULFTR
XMCGM
DELTAE
XJ
  DRAGA
ISPF
,ULFTA
,CODAE
,SID
   *LIFTR
   DBR
ULFT
XMCGR
CALPHA
XCG
   , DB
, ULFTV
, XMCGA
, CDE
, ZCG
   , GAMMAD
   ,xK6
  , XKP
  XK1
XK1D
XK1V
XK1P
XK1D
XK1M
PR
   , XK2
, XK2D
, XK2V
, XK2P
, XK2D
, XK2M
  ,1K3
,1K3D
,1K3V
,1K3P
,1K3D
,1K3D
,1K3D
  GENF
GENF
GENF
GENF
GENF
GENF
GENF
FRAT
SENF
  MACH,
   MÁCHR,
  ADIC3A
ADIC3A
COMN
ABIC3A
  ZERO XL , DVARL, VARL, XLAMA ARRAYS AFTER CALCULATING INDICES
```

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```
NCTIN = (NCN*(NCN*1))/2
NEQB= 6+NCN + NCTIN
I-A CHECK FOR BRANCHING OR INTEREDIATE CONSTRAINTS
TO CORPUTE RANGE OF INTEGRATION ARRAY
IF(INTB-1)10,20,20
   ADIC3A
ADIC3A
COMN
COMN
ADIC3A
      76.
77.
78.
79.
80.
                C
   15-726
                         10 NB =1
NN= 1
       81.
82.
  ADIC3A
  ARTC36
                               60 TO 30
       83.
  ADIC3A
   30
                        20 NB = 4+N1CNB+1
NM = NICNB +1
       84.
35.
  ADIC3A
  ADIC3A
                        30 00 40 1=1, MCM

XLAMP(I)=0.

XLAMA(I)=0.

00 40 1=1, MEQ

XL(J,I)=0.

40 CONTÍNUE

00 50 1=1, MEQB

VARL(I)=0

TOVARL(I)=0.

50 CONTÍNUE
   ADIC3A
ADIC3A
ADIC3A
ADIC3A
ADIC3A
ADIC3A
     86.
87.
88.
91.
92.
93.
94.
95.
96.
Ц
  ADI C3A
   ADICSA
ADICSA
ADICSA
COMM
COMM
COMM
                        50 CONTINUE
                 CCCC
  COMPUTE ADJOINT INITIAL CONDITIONS
                               II-A TEST FOR LINEAR CUT-OFF, YES, SKIP NON-LINEAR CUTOFF CALCULATIONS
IF(JS.LE.9) 60 TO 60
CALL PDBC(JS, DVAR, SX, SFO, 3, 15 KP)
   60-7
  ART C3A
  ADICA
     102.
103.
104.
105.
106.
                        60 CONTINUE
DD 130 I=NN, NCM
II=ITO(I)
II-B SET-UP OR CALCULATE RATE OF CHANGE OF CONSTRAINT
AND IC FOR LINEAR COMSTRAINTS
IF(II.GT.1) 60 TO 70
   ADIC3A
ADIC3A
   ADICSA
COMM
COMM
ADICSA
                  C
     108.
                               DFD=1.
60 TO 100
  ADIC3A
ADIC3A
   160-
                        70 IF(II.ST.10) 60 T090
IF(II.EQ.10) 60 T0 80
XL(II-1, I)= 1.
DFD = DVAR(II-1)
GO TO 100
    110.
   ADIC3A
ADIC3A
ADIC3A
    111.
112
113.
114.
   86-
  AD1C3A
  100-
  ADIC3A
                        80 XL(8,1)=1.

DFD=5VA4(8)

60 TO 100

II-C SET-UP AND CALCULATE IC FOR NON-LINEAR COMSTRAINT
    115.
116.
117.
   ADIC3A
ADIC3A
  160
  ABIC3A
    1118.
     119.
                         90 CALL POBC(II, DVAR, XL(1,I), DFO, 3, ISKP)
  ADIC3A
                       100 CONTINUE
     120.
  ADIC3A
                               LOWINGE

IF(JS.LE.2) 60 TO 130

IF(JS.ET.9) 60 TO 110

XL(JS-2,I) = XL(JS-2,I) -DFD/DVAR(JS-2)

60 TO 130
     121.
122.
123.
  ADIC3A
ADIC3A
   130
   110-
  AD1C3A
  ADIC3A
  130-
L 125.
                      110 DO 120 KK=1,7
120 XL(KK,I) = XL(KK,I) - DFD/SFD+SX(KK)
  ADIC3A
  ACT C3A
                     130 CONTINUE

JK=NB

III PRINT ADJOINT ICS AND RETURN

DO 150 1=NN,NCB

DO 140 JJ=1,6

VARL(JK) = IL(JJ;I)

140 JK=JK+1

150 CONTINUE

CALL IPR(10HADJ,IN,CND,XL(1,NN),I,(NCN-NN+1)*9, 0)

MB=NCM

RFTURM
    127.
128.
129.
130.
131.
132.
133.
134.
135.
136.
137.
   ACIC3A
ADIC3A
   COMM
ADIC3A
ADIC3A
ADIC3A
ADIC3A
                  C
  ADIC3A
ADIC3A
ADIC3A
  ADIC3A
ADIC3A
                               RETURN
```

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## SUBRØUTINE ADID3A

#### Subroutine ADID3A

#### Purpose

Subroutine ADID3A computes adjoint discontinuities for different situations using different entry points. It accounts for branching and intermediate constraints as well as most mixed boundary conditions. Mixed boundary condition adjoint discontinuities are handled for elapsed time and functions of elapsed time only.

#### Description

Preliminary calculations at each entry point use the local range of the  $d\psi$  vector to determine which adjoint sets are to be considered.

It should be noted that this subroutine is not called if the cut-off function is on fixed arc time. This routine's entry points are called from BNTG.

| FORTRAN | MATH        | CODE | DESCRIPTION                                         | STORAG     |      | SUBROUTINE                                                                                                                                                                                      | USAGE                                                                            |
|---------|-------------|------|-----------------------------------------------------|------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| SYMBOL  | 5 Y M B O L | CODE | DESCRIF FICH                                        | BLOCK      | LOC  | SUBR CODE                                                                                                                                                                                       | VAR                                                                              |
| CVAR    | ÿ           | M    | State vector derivatives in steepest descent module | /STATE3/(  | 15)  | A01C3A I C<br>A01D3A M C<br>DER3A O C<br>DTF3 I V<br>ENVPRM I C<br>PROPIN O C<br>REU3 I C<br>RKTA3A I C<br>SDER3 O C<br>STP3 I C<br>YREF3 I C                                                   | DYAR<br>DYAR<br>DYAR<br>VO<br>DYAR<br>VO<br>DYAR<br>DYAR<br>DYAR<br>DYAR<br>DYAR |
| IARC    |             | ī    | Arc number                                          | /XCODES/(  | 146) | ADID3A I I I ADJUST I I ADJUST I I AST3 I I BNTG M I ENVPRM I I FNIG GETIT I I MODELA I I PROPIN I I REU3 I I SDINP M I STAU I STAU I I I | IARC IARC IARC IARC IARC IARC IARC IARC                                          |
| ІРН     |             | I    | Phase number                                        | /XCODES/(  | 143) | ADJUST I I AST3 I I BNTG M I FNTG M I GETIT I I GUISA I I                                                                                                                                       | IPH<br>IPH<br>IPH<br>IPH<br>IPH<br>IPH<br>IPH                                    |
| 15 KP   |             |      | Flag to stop redundant computation in subroutine    | /AD103A/(* | )    | ADID3A W 1                                                                                                                                                                                      | ISKP                                                                             |
| 110     |             |      | Constraint option code (internal)                   | /xcobes/c  | 1)   | ADIC3A I I<br>ADID3A I I<br>CON3 I I<br>SDINP M I<br>STAU I I                                                                                                                                   | 170'<br>170<br>170<br>170<br>170<br>170<br>1110                                  |
| JPS     |             | 1    | Absolute value of phase cut-off option code         | /XCOBES/(  | 152) | BNTG M S<br>FNTG M S<br>STP3 I                                                                                                                                                                  | JPS<br>JPS<br>JPS<br>JPS<br>JPS                                                  |
| J\$     |             | I    | Absolute value of arc cut-off option code           | /XCODES/(  | 153) | ADIC3A I ADID3A I BNTG M FNTG M PROPB I PROPIN I STP3 I                                                                                                                                         | 15<br>15<br>15<br>15<br>15<br>15<br>15<br>15                                     |

| FORTRAN | MATH                           | CODE DESCRIPTION                                 | STORAGE            | S JAROUTINE USAGE                                                                                                                                                                                                                          |
|---------|--------------------------------|--------------------------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL                         | DESCRIPTION                                      | BLOCK LOC          | SUBR CODE VAR                                                                                                                                                                                                                              |
| NCN     |                                | I Number of elements in dy                       | /XCODES/( 160)     | ADEQ3A I NCN ADIC3A I NCN ADIC3A I NCN ADIUST I NCN AST3 M NCN BST3 I NCN BST03 I NCN MTX3A I NCN MTX3A I NCN MTX3A I NCN TEST M NCN TEST M NCN TEST M NCN TEST M NCN TRAN3 I NCN TRAN3 I NCN                                              |
| NEQ     |                                | I Number of integrated states                    | /xc0DES/( 162)     | ADICBS I NEQ<br>ADICSA I NEQ<br>ADICSA I NEQ<br>ADICSA I NEQ<br>ASTS I NEQ<br>BSETS I NEQ<br>BSETS I NEQ<br>BSTOS I NEQ<br>DUT I NEQ<br>CUT I NEQ<br>SDERS I NEQ<br>SDERS I NEQ<br>SDERS I NEQ<br>SDERS I NEQ<br>TOPM I NEQ<br>TRANS I NEQ |
| OMGZ    | ω                              | I Earth rotation rate (RAD,                      | /SEC) /GLŪBAL/( 3) | ADID3A I OMGZ CRASH I OMEGA DER3A I OMGZ EQUA3 I OMGZ GEINP I OMGZ MODELA I OMGZ MODELB I OMGZ POBC I OMGZ PDY3A I OMGZ SDINP I OMGZ TOPM I OMGZ                                                                                           |
| SFO     | $\dot{\Omega}$                 | I Rate of change of cut-off function             | /ADI03A/(+ )       | ADID3A I SFD                                                                                                                                                                                                                               |
| SX      | aΩ/ay                          | I Partial of cut-off WRT state                   | /ADID3A/(* )       | ADID3A I SX                                                                                                                                                                                                                                |
| хL      | $\lambda^{\Psi_1\Omega_J^{'}}$ | M Matrix of adjoint variables                    | /STATE3/( 246)     | ADEQSA M XL ADICSA M XL ADICSA M XL ADICSA M XL ASTS M XL BGETS O XL BGTS I XL MTXSA I XL OUT I XL STAU M XL STAU M XL TRANS M XL                                                                                                          |
| YOP     |                                | I Array of state derivatives at phase end points | /\$TATE3/( 327)    | ADID3A I YDP<br>REU3 O YDP                                                                                                                                                                                                                 |
| YOS     | ÿl <sub>Ţ</sub>                | I Array of state derivatives at arc end points   | /STATE3/( 507)     | ADICBS I YDS<br>ADIDSA I YDS<br>REUS O YDS<br>STAU I YDS                                                                                                                                                                                   |

```
SUBROUTINE ADID3A(JA)
COMPUTES ADJDINT DISCONTINUITIES FOR DIFFERENT
SITUATIONS USING DIFFERENT ENTRY POINTS
ENTRY ADIDSE BRANCH Z APPROACHING TRUNK OR INTER CONST
ENTRY ADIDSSE NORMAL MODE
ENTRY ADIDSSE NORMAL MODE
ENTRY ADIDP = PHASE CORNER NORMAL MODE
   ADIDSA
CORN
COMN
COMN
COMN
COMN
               1, 23, 4, 567,
  000000
  COMN
  GLOBAL
GLOBAL
               8
   YMUPF
  ,LUM
,ID(4)
   10.
   , NF AR C
  GLOBAL
   GLOBAL
GLOBAL
RETAP
IPFL62, IPFL63, IPFL64, INEQFL(20)
  TOL(9) , SVAR(10) , COTI(9,9) , DCON(9) , DCON
  GENF
GENF
  , WDC(20)
, DTP
, QS
, CS
, SUMSQ
, TR(9)
, W
, DMP
, TBU(20)
   , BL
, G
, MACH
, FOR
, TIMES
(20), DISI(20)
, DIRAG
, FPOLD
, FVAC
, OBR
   GENF
GENF
GENF
GENF
   GENF
GENF
GENF
GENF
  , MACHV
   DRAGR
ISP
ULFTR
XMCGM
DELTAE
  DRAGA
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  , BBR
ULFT
, XMCGR
, CALPHA
, XCS
   ULFTV
XACGA
CDE
ZCG
   +XMCG
+CULFT
   , xacev
   ,CT
,SIDAE
   *COB
COMMON / GÉNF /
*XJV XJR
*CRATED , IRATED
  , GAMMAD
  , XKG
   , XKP
  , XK3
, XK3D
, XK3V
, XK3P
, XK3D
, XK3M
, DPDY(3,8)
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  , XK1
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  , XK1D
, XK1V
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, XK1O
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   GENF
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  JGID(20,2), JPH (20,2), NSAB , NICNB , IFB , IND , IFB , IND , IFB , ISTART , JPS , JS , NADD , NCASE , NPH , ISTAPP , ISTAPP , NPHP , 
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  *1T0
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   (20), ITI , INTB , JGIDL2 , NCNST , NSB , NSAB , NSAB , IFAR , IFAR , IFAR , IFAR , IFAR , IFAR , ISST , IARC , IVAR , JK , JK , JPS , NEQ , NOP , NPH , IPRINT , ISTN , IPHN 1 , IBLK2 , ISTOP , ISTPP , ISTP
  ICOP
IPH
ITER
KPST
NEOB
IPST
IBLK1
  *KOP
*NCN
   JPŹ,JP3
   ,5VY(10)
,5AVBP(15)
,0CORO2
  DVARL(99)
  , YO( 9)
, SINGAM
, OCORHO
  , COSGAM
, COSRHO
   USSP

9),0KEG

6DV

VDG

VDG

VDR

VDDR

V
   , ADV
, ROS
, ADR
, ADM
, UDP
, HTDR
   PDV
PDG
PDR
PDM
VDO
   ,000
,000
,008
,VOP
,600
  STATE3D
ADID3A
COAN
  ,CO526#
   C
   SECOND BRANCH
```

20 DCT 72 6 01-46

```
76.
77
78.
79.
80. C
81.
82.
  ADID3A
ADID3A
ADID3A
ADID3A
COMN
ADID3A
                               N1= JA

N2= MCN

GO TD 10

ENTRY ADIDSS

11 SET UP FOR NORMAL MODE

15KP=0
  10-
                                N1=1
N2=NCN
   ADID3A
   ADI 03A
      84.
85
   ADID3A
ADID3A
                          10 CONTINUE
                         KIK=1
IF(JS.LT.9) GO TD 40
KK=JS
III COMPUTE PARTIALS FOR CUTOFF FUNCTION
DD 20 I=1,NEQ
20 DVAR(I)= YOS(IARC-1,I)
      86
81
88
89
   ADID3A
ADID3A
COMM
ADID3A
  40-
 d
   ADID3A
                         30 CALL PD8C(KK,DVAR,LX,SFD,3,ISKP )
40 GO TO (50,100),KIK
       91
   ADID3A
   ADID3A 50 100
      92
     93.
94.
95.
96.
97.
98.
99.
                         50 CONTINUE IV COMPUTE ADJOINT DISCONTINUITY FOR ARC CORNER
   ADIDSA
COMN
COMN
                               DO 90 I=N1 N2
11 = ITQ( 1)
17 = 0.
1F(II = Q 14.0R II = Q 20 ) TT = DMGZ
DO 60 IK=1,NEQ
TT = TT + XL(IK,I)* YDS(IARC-1,IK)
IF(JS.GT. 9) 60 TO 70
XL(JS-2,I) = XL(JS-2,I) - TT / YDS(IARC-1,JS-2)
DO 80 11-1 7
  ADID3A
ADID3A
ADID3A
ADID3A
ADID3A
     101
102
103
104
105
   ADID3A
ADID3A
ADID3A
ADID3A
   ADIDSA 90-
                         70 DO 80 JJ=1,7
80 XL(JJ,I) = XL(JJ,I) - TT/SFD*SX(JJ)
  ☐ 106
107
   ADID3A
ADID3A
     108
109
110.
111.
112.
113.
114.
115.
                         90 CONTINUE
RETURN
   ADID3A
   ADID3A
COMN
COMN
ADID3A
                                V COMPUTE ADJOINT DISCONTINUITY FOR PHASE CORNER ENTRY ADIDP
IF(JPS.LT.9) GO TO 100
KK= JPS
KK= JPS
KK=2
GO TO 30
   ADID3A
ADID3A
ADID3A
ADID3A
  160-
110
117
118.
119
120
121
122
123
124
                       100 CONTINUE
DD 140 I=JA,NCM
TT =0.
D0 110 IK=1,NE0
110 TT = TT + XL(IK,1) +YDP(IPH-1,IK)
IF(JPS-GT.9) 60 TO 120
XL(JPS-2,1) = XL(JPS-2,1) -TT / YDP(IPH-1,JPS-2)
G0 TD 140
   ADID3A
ADID3A
ADID3A
   ADID3A
ADID3A
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ADID3A
ADID3A
  C 125
                        120 DG 130 JJ=1,7
130 XL(JJ,1) = XL(JJ,1) - TT /SFD *5X(JJ)
   ADID3A
ADID3A
      127.
128
129
                       140 CONTINUE
RETURN
END
   ADID3A
ADID3A
ADID3A
```

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# SUBRØUT I NE ADJUST

#### Subroutine ADJUST

#### Purpose

Subroutine ADJUST has several entry points; each is described below.

#### Description

Entry ADJUS. This entry adjusts initial states that are to be optimized. It will also set the arc time optimization flag, ITI, if the first arc time duration is to be optimized. After computing the adjustable parameter increment in MTX1, the free initial state is adjusted and the sensitivity is removed from the sensitivity matrix. The number of free parameters is also reduced appropriately.

Entry ADJIN. This entry checks for arc time duration optimization in the prior arc. If it occurs, the logic eliminates the appropriate elements in the sensitivity matrix and reduces the number of free parameters by one.

The entry points in this routine are called by FNTG.

Entry ADJUT. This entry adjusts the free arc time cut-off value using the currently computed value of the parameter correction. It also forces a concurrent phase-time cut-off to occur at the same time as the arc-time cut-off.

| FORTHAN | MATH   | COOE | DESCRIPTION                                                                                 | STORA     |      | SUBBOUTINE USA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------|--------|------|---------------------------------------------------------------------------------------------|-----------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL |      | DESCRIPTION                                                                                 | BLOCK     | LOC  | SUBH CODE VA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| OPAR    | δρ     | ı    | Adjustable parameter corrections                                                            | /PARAM /t | 264) | ADJUST I OPAR<br>MTX3A M OPAR<br>TOPM D DPAR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| IARC    |        | ī    | Arc number                                                                                  | /xcodes/( | 146) | ADICB3 I IARC ADID3A I IARC ADID3T I IARC ASI3 I IARC BNTG M IARC ENVPRM I IARC FNTG M IARC MODELA I IARC PROPB I IARC PROPB I IARC PROPB I IARC STORM STORM STORM THEOSITY THEOSITY TO ARC TH |
| ICOR    |        | I    | Phase sequence array                                                                        | /XC00E5/( | 10)  | ADJUST I ICOR<br>FNTG I ICOR<br>PRMSET I ICOR<br>SDINP M ICOR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| ІРН     |        | I    | Phase number                                                                                | /XCOBES/C | 143) | ADID3A I IPH ADJUST I IPH AST3 I IPH BNTG M IPH FNTG M IPH GETIT I IPH GETIT I IPH SUIJAA I IPH SUINP M IPH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| IPOINT  |        | ī    | Code for each adjustable parameter in steepest descent.                                     | /PABAM /( | 1)   | ADJUST I IPOI<br>PRMSET I IPOI<br>SDINP O IPOI<br>STAU I IPOI<br>TOPM D IPOI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 171     |        | M    | Optimized arc time flag                                                                     | /XCODES/( | 30)  | TTI B TRUCCA<br>TTI B BTM T<br>TTI G GNIDS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| KST     |        | I    | Arc or phase cut-off flag                                                                   | /XCODES/( | 157) | ADJUST I KST<br>FNTG M KST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| NCM     |        | 1    | Number of elements in d¥                                                                    | /XCODES/C | 160) | ADERSA I NCN ADICBS I NCN ADICBS I NCN ADICBS I NCN ADIUST I NCN ASTS M NCN BSTOS I NCN MTXSA I NCN DUT I NCN TEST M NCN TEST M NCN TEST M NCN TRANS I NCN TRANS I NCN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| NP AR   |        | M    | Running count of number of adjustable parameters to be perturbed on remainder of trajectory | /PARAM /( | 14)  | ADJUST M NPAR<br>FNTG I NPA<br>MTX3A I NPA<br>TOPM D NPA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| FORTRAN | MATH               | CODE DESCRIPTION                                                                                      | STORAGE                | SUBROUTINE USAGE                                                                                                                       |
|---------|--------------------|-------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL             | DESCRIPTION                                                                                           | BLOLK LOC              | SUBRICODE VAR                                                                                                                          |
| NPARA   |                    | I Number of adjustable parameters in traj<br>problem.                                                 | ectory /PARAM /( 1     | BNTG I NPARA BNTG I NPARA FNTG I NPARA MTX3A I NPARA PAY02 I NPARA PRMSET I NPARA SDINP M NPARA STAU I NPARA TEST I NPARA TEST I NPARA |
| OMG     | $\Omega^{J}$       | M Array of arc cut off values [sd]                                                                    | /GENF /(               | 1) ADJUST M OMG FNTG I OMG PRMSET M OMG PROPB I OMG SDINP M OMG STP3 I OMG TOPM D 10MG                                                 |
| OMGP    |                    | O Array of phase cut off values Esd3                                                                  | /GENF /( 2             | 1) ADJUST 0 OMGP<br>FNTG M OMGP<br>PRMSET 0 OMGP<br>SDINP M OMGP                                                                       |
| OMP     |                    | O Phase cut-off value                                                                                 | /GENF /( 49            | 4) ADJUST O OMP<br>FNTG M OMP<br>STP3 I OMP                                                                                            |
| PARA    | P                  | I Adjustable parameter nominal values.                                                                | /PARAM /( 25           | 2) ADJUST 1 PARA<br>PRMSET M PARA<br>TOPM D PARA                                                                                       |
| SPARA   | S <sup>♥</sup> i   | I Matrix of adjustable parameter sensitive (including all parameters)                                 | ities /PARAM /( 1      | 5) ADJUST I SPARA<br>PAYOZ I SPARA<br>STAU M SPARA<br>TOPM D SPARA                                                                     |
| SPARB   | s <sup>¥</sup> i   | O Matrix of adjustable parameter sensitive (Contains only elements corresponding tyet to be adjusted) |                        | 4) ADJUST O SPARB<br>MTX3A I SPARB<br>TOPM D SPARB                                                                                     |
| SVAR    | y l <sub>t=0</sub> | O Array of state values at instial proble                                                             | matime £sd) /GENF /( 7 | 9) ADJUST D SYAR BNTG I SYAR FNTG I SVAR PRMSET M SVAR REU3 I SVAR SDINP M SYAR TEST I SVAR TOPM I SVAR TRTOSZ I SVAR                  |
| SZINV   | [\$\$]             | O Parameter sensitivity contribution to A                                                             | matrix /PARAM /( 27    | 6) ADJUST O SZINV<br>MTX3A M SZINV<br>PAYOZ M SZINV<br>TOPM D SZINV                                                                    |

| FORTRAN<br>Symhol | MATH<br>Symbol | CODE       | DESCRIPTION |          | STORAL<br>BLOCK | GE<br>LOC | <u> 5                                   </u>                               | TINE | USAGE<br>VAR                             |
|-------------------|----------------|------------|-------------|----------|-----------------|-----------|----------------------------------------------------------------------------|------|------------------------------------------|
| VAR               | v              | M Relative | e velocity  | (FT/SEC) | /STATE3/(       | 1)        | ACCEL AOI CAC AOI UST AGET B3 AST B1 B |      | V V AR AR AR V V V AR AR AR AR V V V V V |

ADJUST

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```
ADJUST
COMN
COMN
   SUBROUTINE ADJUST
  COMPUTES ADJUSTMENTS IN OPTIMIZED INITIAL STATES COMMON/SENF/
  TOL(9),
COTI(9,9)
DPSQ
PA
CSR
TOP
DIS1(20),
DIS1(20),
FPD
DRAGV
DR
  GENE
   , MDC(20)
, DIP
, QS
, CS
, SUMSQ
, TR(9)
, W
, OMP
, TBU(20)
  *0MG(20)
*A(9,9)
*DTS
  SVAR(10)
   DCON( 9)
  , Q
. RD
   T
TIME
TBURN
  +AE
+OR
+LIFTR
  MACHE
  MACHY
   GENF
GENF
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   GENF
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   GENF
GENF
GENF
   GENF
GENF
GENF
FRAT
GENF
  GENTE 3D
STATE 3D
   PARAM
PARAM
PARAM
XCODES
  TZULGA
TZULGA
TZULGA
  ADJUST
ADJUST
ADJUST
ADJUST
ADJUST
```

265

```
SVAR(KK+1)=VAR(KK)
           76
   TZULDA
77 78. CC 199 CC 80. CC 82. CC 83. CC 85. 87. 889. CC 97. 94. 995. 996. 997. 995. 996. 997. 1000 1001.
  ADJUST
COMN
COMN
COMN
                                    10 CONTINUE
   1-B SAVE SENSITIVITIES FOR USE IN MIX
                                   OD 20 1=1,NCN

OD 20 1=1,NPARA

20 SPARB(I,J)= SPARA(I,J)

ARC TIME DURATION

ITI = 0

KM=0

20 CONTINUE

CALL MTX

CALL MTX1
  I-C COMPUTE INITIAL STATE CORRECTIONS
AND REMOVE SENSITIVITY FROM MATRIX
DO 110 1=1,NPARA
IF(IPOINT(I).EQ 1) ITI=1
IF(IPOINT(I).E 21) GO TO 110
KK= IPOINT(I) - 21
VAR(KK) = PARA(I) + DPAR(I)
SVAR(KK+1)= VAR(KK)
NPAR = NPAR-1
DO 100 J=1,NCN
100 SPARBLJ,I)=0
   110-
                                110 CONTINUE

D0 120 J=1, NCN

D0 120 I=1, NCN

120 S2INV(I,J)=0

RETURM
  ADJUST
ADJUST
ADJUST
ADJUST
ADJUST
COMM
COMM
                       102.
103.
104.
106.
107.
108.
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111.
112.
113.
114.
115.
COMM
ADJUST
1117
1118.
119
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121
122.
   ADJUST
  122.

123.

124

125

126.

127.

128

129

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131.

132.

133.
  ADJUST
ADJUST
ADJUST
ADJUST
ADJUST
ADJUST
ADJUST
ADJUST
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ADJUST
ADJUST
ADJUST
ADJUST
ADJUST
ADJUST
ADJUST
        134
135.
136
137
   ADJUST
```

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# SUBRØUTINE AGETB3

#### Subroutine AGETB3

#### Purpose

Fetches state and control from random access file for use in adjoint solution.

#### Description

This routine has two entry points.

Entry BEGNA: This entry initializes reading the forward trajectory at final trajectory time. This initialization involves determining the last buffer number that was written into and how many words were written there. Starting from there the program may proceed backwards to extract data at monotonically decreasing time points to correspond exactly with the adjoint integration time points. BEGNA is called from BNTG.

Entry AGETB: This entry simply steps backward in the buffer array and loads the trajectory data into the appropriate common locations. When the starting location of the buffer is reached, the next lower buffer is loaded in from the random file and the process of backward data extraction starts over. AGETB is called from MODELB.

| OHTHAN       | MAIH   | CODE | DESCRIPTION                                                                                                                                         | STORAG     |      | <u>SUBABUTIA</u>                                                                                  |                                                              |
|--------------|--------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------|------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| 2 A WILD F   | SYMBOL |      | DESCRIPTION                                                                                                                                         | BLUCK      | LOC  | SUBB COC                                                                                          | E VAR                                                        |
| <b>АР НЯ</b> | α      | 0    | Angle of attack . (DEG)                                                                                                                             | /AEC03 /(  | 2)   | AGETB3 O<br>AST3 M<br>BEROCO I<br>BLGCON O<br>GUI3A M<br>MODELA M<br>MODELB I<br>MTX3A O<br>OUT I | APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR |
| E            |        | 1    | Storage retrieval buffer                                                                                                                            | /AGETB3/(# | •    | AGETB3 1                                                                                          | E                                                            |
| FTIME        |        | 0    | Time at which trajectory data set is stored. (SEC)                                                                                                  | /RETREV/(  | 1)   | AGETB3 0<br>AST3 0<br>GETIT I<br>TRAN3 I                                                          | FTIME<br>FTIME<br>FTIME<br>FTIME                             |
| IBLK2        |        | M    | Storage retrieval buffer counter                                                                                                                    | /xcodes/(  | 174) | AGETB3 M<br>AST3 M                                                                                | IBLK2<br>IBLK2                                               |
| IBUF2        |        | M    | Counts number of buffers as forward trajectory data is retrieved from random file.                                                                  | /RETREV/(  | 9)   | AGETB3 M<br>AST3 M                                                                                | IBUF2<br>IBUF2                                               |
| IFAR         |        | I    | File where nominal trajectory data is read from                                                                                                     | /xcodes/(  | 139) | AGETB3 I<br>AST3 I<br>TOPM M                                                                      | IFAR<br>IFAR<br>IFAR                                         |
| IPHN         |        | M    | Stored history data phase number                                                                                                                    | /XCODES/C  | 170) | ASETB3 M<br>AST3 M<br>GETIT I                                                                     | IPHN<br>IPHN<br>IPHN                                         |
| ISTN         |        | 0    | Stored history data arc number                                                                                                                      | /xcodes/c  | 169) | AGETB3 O<br>AST3 O<br>GETIT I<br>TRAN3 I                                                          | ISTN<br>ISTN<br>ISTN<br>ISTN                                 |
| JP1          |        | PS   | Option flag for first governing equation                                                                                                            | /XCODES/(  | 217) | AGETB3 M<br>AST3 M<br>MODELA M<br>MODELB I<br>PROPB O<br>PROPIN O                                 | JP1<br>JP1<br>JP1<br>JP1<br>JP1<br>JP1                       |
| 1P3          |        | a    | Option flag for third governing equation                                                                                                            | /XCODES/(  | 219) | AGETB3 D<br>AST3 M<br>MODELA M<br>MODELB I<br>OUT I<br>PROPIN O                                   | JP3<br>JP3<br>JP3<br>JP3<br>JP3                              |
| MAXA         |        | 1    | Number of words in last stored partial buffer of<br>trajectory data MAXA(1) corresponds to random file<br>39 MAXA(2) corresponds to random file 40. | /RETREV/(  | 3)   | AGETB3 I<br>AST3 M                                                                                | MAXA<br>Maxa                                                 |
| MIXA         |        | I    | Maximum number of words in trajectory data buffer = 990.                                                                                            | /RETREV/C  | 12)  | AGETB3 I<br>AST3 I<br>SDINP I<br>TOPM D                                                           | AXIM<br>AXIM<br>AXIM<br>AXIM                                 |
| MXA          |        | I    | Index of last stored word in full buffer of forward trajectory data.                                                                                | /RETREV/(  | 14)  | AGETB3 I<br>AST3 I<br>SDINP D                                                                     | MXA<br>MXA<br>MXA                                            |
| NBUFA        |        | I    | Number of buffers of trajectory data stored on random files 39 and 40 respectively.                                                                 | /RETREV/(  | 6)   | AGETB3 1<br>AST3 M                                                                                | NBUFA<br>NBUFA                                               |

| CHIRAN | MAIH   | CODE         | DESCRIPTION       |          | STORA     | 3E   | <u> 3 ปริกิติป</u>                                                                                                            | TINE USAGE                                                                                                        |
|--------|--------|--------------|-------------------|----------|-----------|------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| SYMBOL | SYMBUL | CODE         | DESCUIPITON       |          | BLÜCK     | LÜC  | SUBR                                                                                                                          | RAV 3000                                                                                                          |
| NEQ    |        | I Number of  | integrated states |          | /XCODES/( | 162) | ADIC3AA<br>ADIE3A<br>ADIE3A<br>ASIE33<br>ASIE33<br>BSTX3A<br>BUUX<br>BSTX3A<br>OUUX<br>SCOLING<br>TREDENM<br>TREDENM<br>TRAF3 | I NEO                                                                                                             |
| PHID   | ø      | O Bank angle |                   | (DEG)    | /AEC03 /( | 10)  | AGETB3<br>AST3<br>GUI3A<br>MODELA<br>MODELB<br>MTX3A<br>OUT                                                                   | M PHID<br>DIH9 M<br>GIH9 M                                                                                        |
| VAR    | •      | O Relative v | elocity           | (FT/SEC) | /STATE3/( | 1)   | ACCECES ADIUTE ADIUTE AST3 BL47 ASL47 BL48 BL8 3 A A A B B B B B B B B B B B B B B B B                                        | M VAR O VAR I VAR I V VAR |

| CCC |                | DUTINE AGE<br>FETCHES |                                             | INTROL FROM B                   | ANDOM ACCES!         | S FILE             | CO     | GET<br>OMN<br>OMN |
|-----|----------------|-----------------------|---------------------------------------------|---------------------------------|----------------------|--------------------|--------|-------------------|
| č   |                | FOR USE               | IN ADJOINT                                  | SOLUTION                        | •                    |                    | CC     | OAN               |
| č   |                |                       | GNA INITIA                                  |                                 | .S                   |                    |        | Į MN              |
| ε   | COMM           |                       | ETB FETCHES                                 | S DATA<br>E,MAXA(2),MAX         | 'R                   |                    |        | OMN<br>Eth        |
|     | CDMM           | JN/RETREV/            | •                                           | •                               |                      |                    |        | ĒTA               |
|     | ≠NBUF          | A(2) TRIE             | F1 ,IBU                                     | 2 ,NBFA                         | , NBFB               | MIXA               | , RE   | ETA               |
|     | ≠el XB         | AXM.                  | , rsx B                                     | , NPTA                          | , NPTB               | IBLKB              | RE     | ETR               |
|     | ≠, <b>N</b> BU | FB IBU<br>DN/STATE3/  | F B                                         |                                 |                      |                    |        | ETR<br>Tat        |
|     | *VAR(          | 14) RVA               | R (14).VARI                                 | . (99) . DVARI                  | (99) . 48(9)         | ,SVY(10)           | 51     | TAT               |
|     | ≠XL{9<br>≠SINP | . ባን                  | ? 2C O\ VBC /                               | . (99) , DVARL<br>20,9), COSEAN | ,SINGA               |                    | ) ( ST | TAT               |
|     | +SINP<br>+SVBV | չլ էննե               | 151 ,5]NI                                   | 1HU , GUSHP                     | io ,ocorni           | , ecoroz           | . 51   | TAI               |
|     | * ADA          | (9), DME              |                                             | HOV                             | ,PDV                 | ,00¥               |        | TAT               |
|     | ¥UDV           | .voe                  |                                             |                                 |                      |                    |        | TAT               |
|     | *UDG           | ADR.                  | KRA                                         | MRR                             |                      | HIIN               | , 51   | TAT               |
|     | +UDR           | . VON                 | . 604                                       |                                 | PHR                  | , VOP<br>, GDO     |        | TAT               |
|     | *6DP<br>*₽00   | ,PDF                  | ,ODP<br>,HTDI                               | , UDP<br>HTDR                   | , voa                | , 600              | 51     | TAT               |
|     | 25.01          | NOM , MOV             | . ADR                                       | ,                               |                      |                    | \$1    | TA1               |
|     | COMM           | 3N/STA1E3/            |                                             |                                 |                      |                    | ST     | TAT               |
|     | *51N2          | RO ,COS:<br>DN/AECO3/ | ana ,cosa                                   | SPI .                           |                      |                    |        | TAT               |
|     | *APHO          | APHI                  | R ,ALPI                                     | A ,VDA                          | , GDA                | PDA                | AE     | ĒČί               |
|     | *SINA          | casi                  |                                             |                                 |                      |                    | , AE   | ECQ               |
|     | #COSP          | II SOP                |                                             | 1 , XLAPSP                      | (Y) ,XLAMPO          | 43 1310            | , AE   | ECC               |
|     | ≠CDGM<br>≠CM   | CL0<br>CMA            | FK                                          | XCGM,<br>CMO, CMO, F            | ,ZCGM<br>,CMOM       | CLOH<br>FKH        |        | EC(               |
|     | ≠CLAM          | , CL                  | , CLA                                       | CLM, CMO                        |                      | ,                  |        | ĒČi               |
|     |                | COA<br>XCODES         | , CDM                                       | ,                               | •                    |                    |        | EČC               |
|     | COMM           | ON /XCODES            | <i>(</i>                                    | •                               |                      |                    |        | COL               |
|     | *1TQ<br>*JST   | (9),100<br>(20)       |                                             | ,1MTB<br>NSB                    | ,JGID(2              | 20,2),JPH (20,     |        | 100<br>100        |
|     | *120P          | Ten                   |                                             | 3 I D W                         | IFR                  | , NI CNB<br>, I ND |        | Cor               |
|     | *IOPE          |                       |                                             |                                 | I ARC                |                    | , XC   | ČÕ                |
|     | *ITCT          |                       |                                             |                                 |                      |                    | , XC   | Cor               |
|     | **OP           | KPS<br>NEG            |                                             | , KST<br>, NOP                  | , NAD<br>, NPH       | , NCASE            |        | Coc               |
|     | +HST           | . 115                 | i LIPRI                                     |                                 |                      | ISTNB              | , xc   | Cot               |
|     | *IPHN          |                       | KI . IBL.                                   | (2 .1510P                       | .15166               | . L                | . XC   | COL               |
|     | +1F0B          | NB                    | LB                                          | PRP,JGII,MTT                    | NPHP                 | NPHB               | , XC   | COE               |
|     | +NCTI<br>COMM  | N/GENF/               | F , ILAB(8),.                               | 16KL'1971'                      |                      |                    |        | COL               |
|     | #086C          | 20) OnG               | P(20.2).VAR                                 | (9) ,TOL(9                      | ) SVAR()             | (0) ,HDC(20)       |        | ENF               |
|     | #A(9,          | ACD                   | P(20,2),VAR(<br>N(9) ,BCOI                  | 8891 EDISE                      |                      |                    | , 6E   | ENF               |
|     | ¥BTS<br>*R     | . กา                  | _ Fi                                        | . 0250                          | , 90<br>, 80<br>, 80 |                    |        | ENI               |
|     | * 4 M D        | RE<br>PAR             | ROD                                         | PA<br>CSR                       | , NU<br>VNR          | CS<br>SUMSO        |        | ENF               |
|     | *\$V\$D        |                       |                                             | :S . I !!P                      | .TOS                 |                    | . 66   | ENF               |
|     | <b>*TST</b> (  | 20) TPH               | (20).0150                                   |                                 |                      | <b>u</b>           | , GE   | ENF               |
|     | ¥TLP1<br>¥TIMP | 701 115               | L 7703 BIP                                  | (761 81516                      | THE ,TBURN           | OMP<br>TBU(20)     | , cc   | ENF<br>Enf        |
|     | +11FFF         | , LIF                 | T , DRAI<br>, EPOI                          | TAX<br>D FPD                    | , HACHR              | MACHY              |        | ENF               |
|     | *QR            |                       | . FVAI                                      | ; ,LIFTY                        |                      | •                  | ÉGE    | ENF               |
|     | #LIFT          | ,LIF                  | T A                                         | DRAGV                           | DRAGE                | DRASA<br>, ISPF    | . \$6  | ENF               |
|     | *              | LIF                   | TÄ ,DBR<br>ULF1                             | , DB<br>, ULFT V                | JI 5 P               | ,ISPF<br>,ULFTA    | * 65   | ENF<br>ENF        |
|     | +×AC6          | , XMC                 | EN ÄNLI                                     | ak zmriad                       | I INCHE              | CHUAF              | , ce   | ENF               |
|     | +CULF          |                       | . UALI                                      | HA LUDE                         | . UELTAI             | 510                | , GE   | ENF               |
|     | +COD           | .510                  | AE ,XCG                                     | ,ZcG                            | , XJ                 | •                  | GE     | ENF               |
|     | MAG3<br>MAG3   | DN / SENF             | ,                                           | Camma                           | n vrc                | 440                |        | ENF<br>ENF        |
|     | +A34<br>+FRAT  | XJR<br>ED , IRAT      | , 6H<br>ED .                                | , Gamma                         |                      | , XKP              |        | EHF               |
|     | *P1            | .22                   | . 23                                        | XK1                             | , XK2                | , XK3              | , GE   | ENF               |
|     | +XK1T          |                       | 1                                           | E XKIN                          |                      | X 8 3 11           |        | ENF               |
|     | *XK1A          | . 11.12               | A . YX31                                    |                                 | , XK2¥               | 38.38              | 1 65   | ENF               |
|     | *XK16<br>*XK1R | , XK2                 | H YKRI                                      | a xrin                          |                      | , XK3P<br>, XK3D   | , ,,,, | ENF<br>ENF        |
|     | *XX10          | . X X 2               | Û ,2831<br>PP<br>LIFT , LIFT<br>CHV,LIFTV , | a XXIII                         | XK2M<br>PO           | , 1138             | , GE   | ENF               |
|     |                |                       |                                             |                                 |                      | DPDY(3,8           |        | ENF               |

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```
OIMENSION TPH1(10),TST1(10)
EQUIVALENCE(TLP],TPH1),(TLS1,TST1)
DIMENSION E(990)
I INITIALIZE BUFFER NUMBER AND READ FILE
ENTRY BEGNA
KK= NEQ+1
IBUF2 = MBUFA(IFAR-38) +1
IBLK2 = MAXA(IFAR-38) +1
GO TO 20
   GENF
GENF
AGETB3
COMN
AGETB3
AGETB3
AGETB3
AGETB3
   76
77
78.
79
80.
81.
82.
83.
                C
   26-
                          10 IF(BUF2.LE. 1) RETURN
18LK2 = MIA +1
20 IBUF2 = IBUF2 -1
CALL READOS(IFAR,E,MIXA,IBUF2)
RETURN
ENTRY AGETB
   85.
86
  AGETB3
AGETB3
   AGE183
AGE183
AGE183
AGE183
COMM
AGE183
87
88.
89.
91.
93.
94.
95.
97.
98.
99.
1001.
103.
104.
105.
107.
109.
111.
                         C
                                    III IF BUFFER EMPTY GO UP TO 20 AND FILL BUFFER RETURN END
                Ç
```

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## SUBRØUT I NE ANLATM

```
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   001,000
-1.12634032E-2,.38228439E-5/
   ANLAT
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                          DATA
38.
39.
                      DATA
40.412.444.445.447
   ANLAT
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61.
62.
64.
65.
66.
67.
69.
  ANLAT
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ANLAT
                        * 1.7818E-4, 198 , 372., 3 V2E-7, 7.12-12., 4 590./

POMER(Z) = A1/(Z + A2) + A3*ALDG(Z + A4) + A5*ALDG(Z + A6) + A7*ALDG(A8 - Z) + A9*ALDG(Z*(Z - A1C) + A11) + A12*ATAN(A13*Z - A14) + A15*ALDG(Z*(Z - A16) + A17) + A18*ATAN(A19*Z - A20) + A21*ALDG(Z*(Z + A22) + A23) * A24*ATAN(A25*Z + A26) + A27*ALDG(Z*(Z + A28) + A29) + A30*ATAN(A31*Z + A32)
   ANLAT
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ANLAT
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ANLAT
ANLAT
                   40 X = H * X12

IF (X .6T. 550.) X=550.

IF (X .LT. 0.) X= 0.

IF (X.6T 195.) GD TO 1000
```

1665

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```
76. C
  ANLAT
ANLAT
ANLAT
  SET CONSTANTS
POWERX= POWER(X)
         TM = C10 + X*(C9 + X*(C8 + X*(C7 + X*(C6 + X*(C5 + X*(C4 + X*(C3 + X*(C2 + X*(C1 + X*(C3 + X*(C6 + X*(C5 + X*(C4 + X*(C3 + X*(C6 + X*(
   ANLAT
   ANI AT
  ANLAT
ANLAT
           84.
85
           86
87
  ANLAT
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ANLAT
ANLAT
ANLAT
   RHO = ROWXTG*EXPO/TM
DYNAMIC VISCOSITY CALCULATIONS
           88.
90.
91.
92.
93.
   7 TTF32 = (1.8*TM/TF)*SQRT(1 8*TM/TF)
TSC = 1 8*TM + SC
UMU = COEF1* TTF32/TSC
1F(1NDP.GT.0) 50 T0 500
IF(JP3.LT 7) 60 T0 50
  ANLAT
ANLAT
ANLAT
   500-
  50
         96
97
   499 ASSIGN 600 TO 160
GO TO 510
  ANLAT
  10 310 310 310 310 499

500 IF(JP3.LT.1) GD TO 499

FR2 = CC8 + X*(CCC1 + X*(CCC6 + X*(CCC5 + X*(CCC4 + X*(CCC3 + X*(CCC2 + X*(CCC1 + X*CCC0))))))

1F(JP3-8) 501, 501, 502
         98.
  ANLAT
    99
100
101
  ANLAT
ANLAT
ANLAT
   501-7502-7
    10Z
103.
   501 ASSIGN 601 TO 160
60 TO 510
  ANLAT
  502 ASSIGN 602 TO IGO

510 CONTINUE

TM1 = C9 + X*(CC8 + X*(CC7 + X*(CC6 + X*(CC5 + X*(CC4 + X*(CC3 + X*(CC2 + X*(CC1 + X*(CC0)))))))

CS1= HAFCON * TM1 /SQRTTM

R = 6356.765 + X

G = .396271577E6/R**2

GTM = G/TM

EXP1= EXP**CN**6TM

P1 = P0* EXP1

RHO1= (ROWXTO*EXP1 --RHO*TM1)/TM

TMS = 1.8 *TM

TMS1= X5* TM1

GT = TFSC/ TSC

GT1 = -GT/TSC

FT = TTF32

FT1 = 1.5* FT /IMS

UMU1 = UMUF *(FT*GT1*TMS1 + GT *FT1*TMS1)

GO TO IGO

602 CONTINUE

TMS2 = X9*TM2

GT2 = 2.* GT /(ISC*TSC)

TM20 = TR5*IMS

FT2 = .75 *FT /TM20

UMU2 = UMUF**((FT*GT1 +GT*FT1)*TMS2 +(FT*GT2 +2.*FT1*GT1 +GT*FT2)

* *TMS1*TMS1 )

601 CONTINUE

G1=-2.* G/R

GTM1=(G1*TM-G*TM1)/(TM*TM)
  502 ASSIGN 602 TO 160
    104.
  ANI AT
  ANLAT
ANLAT
ANLAT
    105.
    106
107
108
  ANLAT
ANLAT
ANLAT
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    109.
110.
111.
112
  ANLAT
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    113.
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117.
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  ANLAT
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ANLAT
    120
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136
   ANLAT
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  ANLAT
  ANLAT
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  ANLAT
ANLAT
ANLAT
  CONTINUE
61=-2.*G/R
GTM1=(G1*TM-G*TM1)/(TM*TM)
EXP2= CN*(EXP1*GTM*EXP0*GTM1)
RH02= (R0WXT0*EXP2-2.*RH01*TM1-RH0*TM2)/TM
RORR = X11*RH02
GD TO 600
   ANI AT
  ANLAT
ANLAT
ANLAT
   600
137. 1000 CDM11mc

138. C
139 C TM .GT 195

140 SQRTTM = SQRT(TM)

141 SQRTTM = SQRT(TM)

142 CS=CON*SQRTTM

143. TTF32=(1.8*TM/TF)*SQRT(1.8*TM/TF)

144. TSC =1.8*TM*SC

145. UMU=COEF1*TTF32/TSC
  ANLAT
ANLAT
ANLAT
    137.
  1000 CONTINUE
   ANLAT
  ANLAT
ANLAT
UH
  UH
```

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```
P GT 195

BH0 = E9 + X*(E8 + X*(E7 + X*(E6 + X*(E5 + X*(E4 + X*(E3 + X*(E2 +

* X*(E1 + X*E01))))))

P = B9 + X*(E8 + X*(E7 + X*(E6 + X*(E5 + X*(E4 + X*(E3 + X*(E2 +

* X*(E1 + X*E01)))))))

IF(INDP GT 0) GO TO 400

IF(INDP GT 0) GO TO 50
148
149
150
151
152
153.
154
   ANLAT
  ANL AT
   ANLAT
ANLAT
ANLAT
   400-
   50-
155
156
                               389 ASSIGN 600 TO 160
GO TO 410
  ANI AT
 157
158
                                400 IF(JP3 LT.7) 60 TD 389
IF(JP3-8) 401,401,402
   ANLAT
  ANLAT
   401-1402-
 159
                                  401 ASSIGN 701 TO 160
60 TO 410
   ANLAT
ANLAT
  410
161
                                 402 ASSIGN 702 TO 160
   ANLAT
                             402 ASSIGN 702 TO IGO

410 CONTINUE
RH01 = E8 + X*(EE7 + X*(EE6 + X*(EE5 + X*(EE4 + X*(EE3 + X*(EE2 + X*(EE1 + X*EE0))))))
P1 = B8 + X*(BB7 + X*(BB6 + X*(BB5 + X*(BB4 + X*(BB3 + X*(BB2 + X*(BB1 + X*BB0))))))
TM1 = D2 + X*(DD1 + X*DD0)
CS1=HACCON*TM1/SQRTTH
TMS=1.8*TM
TMS1=X5*TM1
GT = TFSC/TSC
GT1 = -GT/ TSC
FT = TTF32
FT1± 1.5 *FT / TMS
UMU1 = UMUF *(FT*GT1*TMS1 + GT *FT1*TMS1)
GD TO IGO
702 CONTINUE
TM2 = DD1 + X*DDD0
TM52 = X9*TM2
GT2 = 2 *GT /(TSC*TSC)
TM20= TMS*TMS
FT2 = 1.75*FT //TM20
UMU2= UMUF *((FT*GT1 + GT*FT1) *TMS2 +(FT*GT2 + 2 *FT1*GT1 +GT*FT2) *
* * *TMS1*TMS1 )
701 CONTINUE
RH02 = EE7 * X*(EEE6 + X*(EEE5 + X*(EEE4 + X*(EEE3 + X*(EEE2 + X*(EEE1 + X*EEE0))))))
RORR=X11*RH02
 162
                                  410 CONTINUE
   ANLAT
ANLAT
ANLAT
ANLAT
ANLAT
UH
ANLAT
 163
164.
165.
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167.
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169
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171.
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182.
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185.
186.
187
  ANLAT
   ANLAT
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ANLAT
  ANLAT
                               600 DIM(5)=X6*P1
DIM(6)=X7*RH01
DIM(7)=CS1
DIM(8)=UMU1
IF(X.GT.O.) 60 TO 50
DO 605 III=5,8
605 DIM(III)=0.
   ANLAT
ANLAT
ANLAT
ANLAT
PHISZ
PHISZ
PHISZ
189
190
191
192
193
194
  50-
                                   50 DIM(1)=X2*P
DIM(2)=X3*RHO
DIM(3)=X4*CS
DIM(4)=UMU
RETURN
END
196
197
198
199.
   ANLAT
ANLAT
   ANLAT
ANLAT
ANLAT
```

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# SUBRØUT I NE AST3

#### Subroutine AST3

#### Purpose

This routine handles both storage and retrieval of trajectory data during forward trajectory integration. Each entry point is defined herein.

#### Description

Entry BEGWR: Initializes counters for storage of trajectory on random file. BEGWR is called from FNTG.

Entry ENDWR: Saves values of counters after trajectory has been stored and "dumps" last partial buffer on random file. ENDWR is called from FNTG.

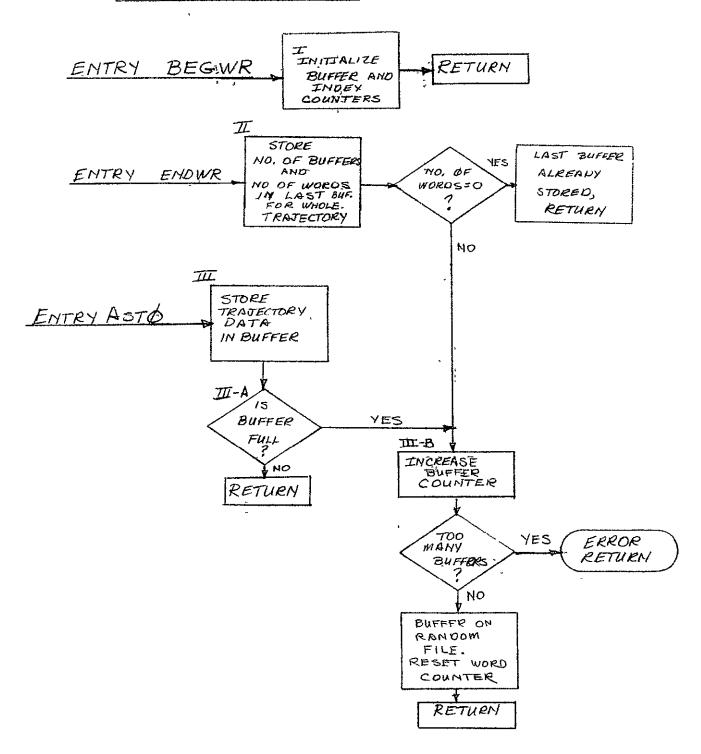
Entry AST $\phi$ : Stores trajectory data in buffer and when buffer is full "dumps" buffer on random file. AST $\phi$  is called from entry CORVAR in REU3 and also FNTG.

Entry BGRA: Initializes read of trajectory data.

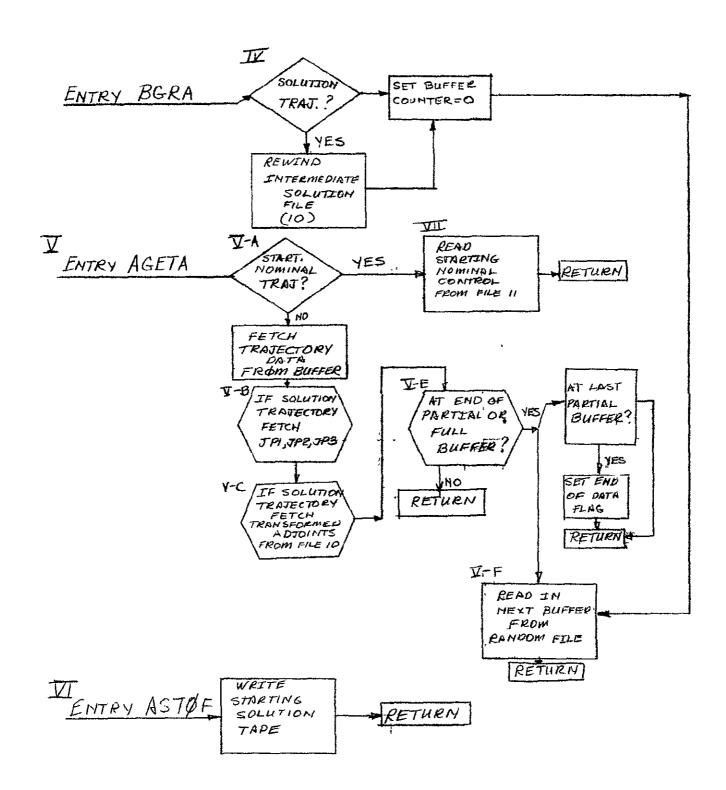
Entry AGETA: Reads data from storage buffer, or if on a starting trajectory, reads data from starting solution file 11. AGETA is called from MODELA.

Entry AST $\phi$ F Writes starting solution on file 11. ASTOF is called from FNTG.

### SUBROUTINE AST3



### SUBROUTINE AST3 (CONTINUED)



| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                                                   |              | STORAG<br>BLOCK | LOC  | SUBROUT<br>SUBR C                                                    | INE USAI                                                                                                                                               |
|-------------------|----------------|------|-------------------------------------------------------------------------------|--------------|-----------------|------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   |                |      |                                                                               |              |                 |      |                                                                      |                                                                                                                                                        |
| APHO              | α old          | M    | Angle of attack from last nominal trajectory                                  | (DEG)        | /AEC03 /(       | 1)   | AST3<br>FNTG<br>MTX3A<br>OUT<br>PROPB<br>PROPIN                      | M APHO I APHO I APHO I APHO O AEZRO                                                                                                                    |
| APHR              | α              | M    | Angle of attack                                                               | (DEG)        | /AEC03 /(       | 2)   | BLGCON<br>GUI3A<br>MODELA<br>MODELB                                  | M APHR<br>I APHR<br>O APHR<br>M APHR                                                                                                                   |
| D                 |                | Ш    | Storage buffer                                                                |              | /AST3 /(*       |      | AST3                                                                 | W D                                                                                                                                                    |
| Ε                 |                | I    | Storage retrieval buffer                                                      |              | /AST3 /(+       |      | AST3                                                                 | IE                                                                                                                                                     |
| FTIME             |                | 0    | Time at which trajectory data set is stored                                   | (SEC)        | /RETREV/(       | 1)   | AGETB3<br>AST3<br>GETIT<br>TRAN3                                     | O FTIM<br>O FTIM<br>I FTIM<br>I FTIM                                                                                                                   |
| IARC              |                | 1    | Arc number                                                                    |              | /xcades/(       | 146) | ADJUST<br>AST3<br>BNTG<br>ENVPRM<br>FNTG<br>GETIT<br>MODELA<br>PROPB | I IARCCI I IARC |
| IBLK1             |                | M    | Storage retrieval buffer counter                                              |              | /XCODES/(       | 173) | AST3<br>BST03                                                        | M IBLK                                                                                                                                                 |
| IBLK2             |                | Ľį.  | Storage retrieval buffer counter '                                            |              | /XCOBES/(       | 174) | AGETB3<br>AST3                                                       | M IBLK                                                                                                                                                 |
| IBUF1             |                |      | Counts number of buffers as forward trajectory stored on random file.         | is           | /RETREV/(       | 8)   | AST3                                                                 | # IBUF                                                                                                                                                 |
| 1 BUF 2           |                |      | Counts number of buffers as forward trajectory is retrieved from random file. | data         | /RETREV/(       | 9)   | AGETB3<br>AST3                                                       | M IBUF<br>M IBUF                                                                                                                                       |
| IFAR              |                | I    | File where nominal trajectory data is read fro                                | · <b>m</b> - | /XCODES/(       | 139) | AGETB3<br>AST3<br>TOPM                                               | I IFAR<br>I IFAR<br>M IFAR                                                                                                                             |
| IFAW              |                | I    | Logical file to write current trial trajectory                                | data         | /XCODES/(       | 138) | AST3<br>TOPM                                                         | I IFAW                                                                                                                                                 |
| IND               |                |      | Flag indicates whether on first nominal trajec<br>(IND=1)                     | tory         | /XCODE5/(       | 141) |                                                                      | I IND<br>I IND<br>M IND<br>I IND<br>I IND<br>I IND                                                                                                     |
| 1 P H             |                | I    | Phase number                                                                  |              | /xcobes/(       | 143) | ADID3A<br>ADJUST<br>AST3<br>BNTG<br>FNTG<br>GETIT<br>GUI3A<br>SDINP  |                                                                                                                                                        |

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| FORTRAN | MAIH   | CODE | DESCRIPTION                                                                                                                                                                          | SIGRAL    |      | SUBROUTINE                                                                                    |                                                                                        |
|---------|--------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL |      | DESCRIPTION                                                                                                                                                                          | BLOLK     | EOC  | SUBA CODE                                                                                     | VAR                                                                                    |
| IPHN    |        | m    | Stored history data phase number                                                                                                                                                     | /XCOĐES/( | 170) | AGETB3 M'<br>AST3 M<br>GETIT I                                                                | IPHN<br>IPHN<br>IPHN                                                                   |
| IPST    |        | I    | Phase counter for first nominal trajectory                                                                                                                                           | /XCODES/( | 167) | AST3 1                                                                                        | IPST<br>IPST<br>IPST<br>IPST                                                           |
| ISTART  |        | 0    | Initialization and divergance flag                                                                                                                                                   | /XCODES/( | 147) | AST3 Q<br>BLGCON O<br>BLYNE O<br>FNTG I<br>MODELA O<br>PROPIN O<br>REU3 I<br>TEST M<br>TOPM M | ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART |
| ISTN    |        | 0    | Stored history data are number                                                                                                                                                       | /XCODES/( | 169) | AGETB3 O<br>AST3 O<br>GETIT I<br>TRAN3 I                                                      | ISTN<br>ISTN<br>ISTN<br>ISTN                                                           |
| ITEA    |        | 1    | Trajectory pass Indicator. ITER = 1, CONSTRAINTS = 2, OPTIMIZATION = 3, SOLUTION                                                                                                     | /XCODES/( | 149) | PROPIN I<br>Test M                                                                            | ITER<br>ITER<br>ITER<br>ITER<br>ITER<br>ITER<br>ITER<br>ITER                           |
| JP1     |        | M    | Option flag for first governing equation                                                                                                                                             | /XCOBES/( | 217) | AGETB3 M<br>AST3 M<br>MODELA M<br>MODELB I<br>PROPB D<br>PROPIN O                             | JP1<br>JP1<br>JP1<br>JP1<br>JP1<br>JP1                                                 |
| JP3     |        | M    | Option flag for third governing equation                                                                                                                                             | /xcodes/( | 219) | AGETB3 0 AST3 M MODELA M MODELB I OUT I PROPIN 0                                              | JP3<br>JP3<br>JP3<br>JP3<br>JP3<br>JP3                                                 |
| ĸ       |        | 0    | Storage retrieval flag indicates end of arc, phase, or data.                                                                                                                         | /XCODES/( | 156) |                                                                                               | K<br>K<br>K<br>K                                                                       |
| LUM     |        | I    | Program control flag.  LUM = 0 · Steepest descent only;  LUM = 1 · Steepest descent and adjoint  transformation stored on tape;  LUM = 2: Steepest descent and QL;  LUM = 3: QL only | /GLOBAL/( | 6)   | FNTG I<br>GEINP I<br>PADS1 M<br>SOINP I                                                       | LUM<br>LUM<br>LUM<br>LUM<br>LUM<br>LUM                                                 |
| MAXA    |        | M    | Number of words in last stored partial buffer of trajectory data MAXA(1) corresponds to random file 39 MAXA(2) corresponds to random file 40.                                        | /RETREV/( | 3)   |                                                                                               | MAXA<br>Maxa                                                                           |
| MIXA    |        | I    | Maximum number of words in trajectory data buffer = 990                                                                                                                              | /RETREV/( | 12)  | AST3 I<br>SDINP I                                                                             | MIXA<br>MIXA<br>MIXA<br>MIXA                                                           |
| ΑXM     |        | I    | Index of last stored word in full buffer of forward trajectory data.                                                                                                                 | /RETREV/( | 14)  | AGETB3 I<br>AST3 I<br>SDINP O                                                                 | AXM<br>AXM<br>AXM                                                                      |
| NBFA    |        | I    | Maximum number of buffers permitted to store forward trajectory data = 20                                                                                                            | /RETREV/( | 10)  | AST3 I<br>TOPM D                                                                              | NBFA<br>NBFA                                                                           |
| NBUFA   |        | W    | Number of buffers of trajectory data stored on random files 39 and 40 respectively.                                                                                                  | /RETREV/( | 6)   | AGETB3 I                                                                                      | NBUFA<br>NBUFA                                                                         |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE             | DESCRIPTION                |       | STORA<br>BLOCK | 3E<br>LOC | SUBACUTINE<br>SUBA LODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | USAGE<br>VAR                                                 |
|-------------------|----------------|------------------|----------------------------|-------|----------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| NCN               |                | កា Number of ele | ments in d∜                |       | /XCDDES/(      | 160)      | ADEQ3A I ADICB3 I ADICB3 I ADICB3 I ADJUST I AST3 BNTG I BST03 I MTX3A I OUT MAYOUT MA | NOCH<br>NOCH<br>NOCH<br>NOCH<br>NOCH<br>NOCH<br>NOCH<br>NOCH |
| NEO               |                | I Number of inf  | egrated states             |       | /xcodes/(      | 162)      | ADICB3 I<br>ADIC3A I<br>ADIC3A I<br>ASTB3 I<br>ASTB3 I<br>BGET3 I<br>BST03 I<br>BTX3A I<br>OUT I<br>REUS I<br>SDINP M<br>TOPM I<br>TRANS I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 00000000000000000000000000000000000000                       |
| PHID              | ¢              | M Bank angle     |                            | (DEG) | /AEC03 /(      | 10)       | AGETB3 O<br>AST3 M<br>GUI3A M<br>MODELA M<br>MODELB I<br>MTX3A O<br>OUT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | PHID<br>PHID<br>PHID<br>PHID<br>PHID<br>PHID<br>PHID         |
| PH10              | $\phi$ old     | M Bank angle fr  | om last nominal trajectory |       | /AEC03 /(      | 9)        | M ETZA<br>I AEXTM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | PHIO<br>OIKS                                                 |
| TIME              | t              | I Time (elapsei  | 3)                         |       | /GENF /(       | 493)      | ADICB3 D<br>AST3 I<br>BNTG M<br>CON3 I<br>ENVPRM I<br>EQUAS M<br>FOTELA I<br>DUT I<br>PODE LA I<br>DUT I<br>PROPIN I<br>REU3 M<br>RKTB3A M<br>RKTB3A M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | TIME TIME TIME TIME TIME TIME TIME TIME                      |
| TIMES             | 7              | I Arc time       |                            | (SEC) | /GENF /(       | 319)      | AST3 I<br>EQUA3 O<br>FNTG M<br>GETIT I<br>OUT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | TIMES<br>TIMES<br>TIMES<br>TIMES<br>TIMES                    |

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| FORTRAN | MATH                                               | CODE | DESCRIPTION                                                  | STORAGE    |           | SUBFILITINE US |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                       |                                                                                                     |
|---------|----------------------------------------------------|------|--------------------------------------------------------------|------------|-----------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-----------------------------------------------------------------------------------------------------|
| SYMMOL  | SYMBƏL                                             | LUUE | DESCRIPTION                                                  |            | BIULK     | LOC            | J J∂⊓                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | .005                                  | VAR                                                                                                 |
| RAV     | •                                                  | 1    | Relative velocity                                            | (FT/SEC)   | /STATE3/( | 1)             | ACCEL A01 CB3 A01 UST A6T183 AST3 8L4 BL7 BL8 CON3 DEFF3 EQUA3 MODELA MODELA MODELA MODELA MODELA FEURAS ADDIT POBC POPSS REVISA STP3 REVISA STP3 REVISA STP3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                       | V VAR<br>VAR<br>VAR<br>VVAR<br>V VAR<br>V VAR<br>V VAR<br>V VAR<br>V VAR<br>V VAR<br>V VAR<br>V VAR |
| XL      | $\lambda^{rac{1}{4},\Omega}$ J                    | M    | Matrix of adjoint variables                                  |            | /STATE3/( | 246)           | TOPM YREF3 ADEOSA ADEOS | M M M M M M M M M M M M M M M M M M M | KW0 W<br>X L<br>X L<br>X L<br>X L<br>X L<br>X L<br>X L<br>X L<br>X L<br>X L                         |
| XLAMA   | $V_{\tilde{\Lambda}^I \tilde{\Omega}^{\tilde{J}}}$ | 0    | Impulse response function column vector with angle of attack | associated | /AEC03 /( | 16)            | TRANS ADEDSA ADICSA ASTS BGETS BSTOS MTXSA TRANS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       | XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA                                |
| XLAMP   | Λ <sup>¥</sup> î <sup>Ω</sup> J                    | Đ    | Impulse response function column vector with bank angle      | associated | /AEC03 /( | 25)            | ADEQ34<br>ADIC34<br>AST3<br>BGET3<br>BST03<br>MTX3A<br>TRAN3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                       | XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP                                |
| YO      | y <sub>old</sub>                                   | 0    | State vector of nominal trajectory                           |            | /STATE3/( | 227)           | AST3<br>MTX3A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0                                     | 70<br>70                                                                                            |

| E. | SUBROUTINE ASTS                          |                                                                     |                      |                   |                  | AS<br>CO    |
|----|------------------------------------------|---------------------------------------------------------------------|----------------------|-------------------|------------------|-------------|
| Ç  |                                          | ARD TRAJECTORY (                                                    |                      |                   | SES              | CO          |
| Ċ  |                                          | CCESS AND SEQUENCES DATA FOR F                                      |                      |                   | ET)              | 00<br>00    |
| č  |                                          | 163 BACA FOR 1                                                      | Braken their         | ecion, two        | ,                | ĆŪ          |
|    | COMMON/GERF/                             | (00 3) VATO(0)                                                      | T01 ( 0 3            | ,SVAR(10)         | , MDC( 20 )      | GE<br>GE    |
|    | *A(9 9) . ACDA                           | (20,2),VARQ(9)<br>(9) ,BCON(9)                                      | TOL(9)               | DEUNIA 3          | DTP              | , SE        |
|    | *87.5 . n <b>r</b>                       | <u> </u>                                                            | DPSQ                 |                   | .05              | . GE        |
|    | ¥N .RE                                   |                                                                     | .PA                  | .PU               | , 95<br>, C5     | , 6€        |
|    | AVNII PAR                                |                                                                     | CSR                  | VNR<br>TOS<br>T   | ,SUMSO<br>TR(9)  | , GE        |
|    | *5 VSQ , TIME<br>*TST(20) .TPH           | PH ,TIMES (20)                                                      | TOP<br>DIP(20)       | , Tus             | 8                | , GE        |
|    | *1LF1(20) .TL51                          | {20} niP1(26)                                                       | DIS1(20)             |                   |                  | . SE        |
|    |                                          |                                                                     | 101                  | . I BIIRN         | .168(20)         | , 6E        |
|    | *AE ,FP *OV                              | FPOLD<br>FVAC                                                       | FPB<br>LIFTV         | MACHR             | MACHY            | , 6E        |
|    | *OR ,OV<br>*LIFTR ,LIFT                  |                                                                     | писку                | DRAGR             | DRAGA            | . ĜE        |
|    | * LIFT                                   | M ,DBR                                                              | nn .                 | 159               | DRAGA<br>,1SPF   | . GE        |
|    | *                                        |                                                                     |                      | 113 F 6 K         | . 111 + 14       | . GE        |
|    | +XMCG ,XMCG<br>+CULFT ,CT                | V , XMCGR<br>, CALPHA                                               | XMCGA<br>CDE         | ,XMCSM<br>,DELTAE | CODAE<br>SID     | , GE        |
|    | +COD ,SIDA                               | E ,XCG                                                              | ZC6~                 | , XJ              | ,510             | , SE        |
|    | CUMPON / GENF                            | 1                                                                   | -                    | -                 |                  | 66          |
|    | *XJV ,XJR                                | , 6H                                                                | GAMMAD               | ,XKG              | , XKP            | , GE        |
|    | *FRATED , IRATE                          | 22                                                                  | ,XK1                 | ,XK2              | ,XK3             | . GE        |
|    |                                          |                                                                     |                      |                   |                  | , SE        |
|    | 41K10 1K20                               |                                                                     |                      |                   |                  | . GE        |
|    | # X X X X X X X X X X X X X X X X X X X  |                                                                     |                      |                   | , XKOP           | , GE        |
|    | *XK1R ,XK2R<br>*XK1U ,XK2U               |                                                                     | XK10<br>XK1M         | XK28<br>,XK2M     | , XK30<br>, XX3M | , SE        |
|    | *P <b>V</b> .PG                          | , PP                                                                | PR                   | .00               | _8787463.87      | , ge        |
|    | DEAL LIETÓ L                             | , tasu<br>, pp<br>ift Lifta Lift<br>HV, LiftV IRATE<br>10),1511(10) | īfi,                 | MACH              | HÁCHR,           | GE          |
|    | * ISP, ISPF, MAC                         | HV, LIFTV , IRATE                                                   | D                    |                   |                  | FF          |
|    | FOUL VALENCE (TIP                        | HV, LIFTV , IRATE<br>10), TST1(10)<br>1, TPH1), (TLS1, TS           | T11                  |                   |                  | 6E          |
|    |                                          |                                                                     |                      |                   |                  | 51          |
|    | *VAR(14) ,0VAR                           | (14), VARL (991<br>20,9), VDS (20,91<br>SI ,SINRHO<br>A ,OMESA2     | ) DVARL(99)          | ,YB(9)            | ,SVY(10)         | , ST        |
|    | +XL(9,9) ,YDP(<br>+SINPSI ,COSF          | 20,9),405 (20,9)                                                    | ),COSGAM             | ,5INGAM           | _58YBP(15)       | , 51        |
|    | +578V (9),0ME6                           | 51 ,518KHU<br>6 38F562                                              | , 605889             | ,utoknu           | ,OCORD2          | , \$1<br>51 |
|    |                                          |                                                                     |                      |                   | .00V             | . 51        |
|    | AUDV USS                                 | ,605                                                                | unc                  | PUE               | , UU 6           | ; 51        |
|    | *UDG ,VDR<br>*UDR ,VDM                   | , SDR                                                               | MDR<br>MDM           | ,PDA<br>,PDM      | ODR<br>VDP       | , ST        |
|    |                                          | , GDM<br>, ODP                                                      | 111112               | ,400              | 600              | : 51        |
|    | #PDO , QDQ                               | , HTDV                                                              | HTDR                 | , - 00            | ,000             | Šī          |
|    | REAL MDM , MDV,<br>COMMON/STATES/        | MDR '                                                               | · •                  |                   |                  | 51          |
|    | *CINSON COCS                             | 00 00000                                                            |                      |                   |                  | ST<br>ST    |
|    | CDMMON/CLOBAL/                           | •                                                                   |                      |                   |                  | 21<br>21    |
|    | *GR ,ER *,JJOP(10),IFAT *,KTAB(20),ITAB( | , BMSZ                                                              | ,XLAMRF              | ,YAURF            | ,LUM             | St          |
|    | *,JJOP(10) (IFAT                         | AL (NARC<br>20) ,516 ,MAX                                           | . NBRAN              | NEARC             | ,ID(4)           | 6L          |
|    | +, KTAB(20), ITAB(<br>+, GM , PSIR       | 20) ,\$16 ,MA:<br>F,IPFLG1, IF<br>,XGLOBL(8)                        | LIAB<br>SELES IDELES | 1051 64 145       | ner ( 203        | GL<br>GL    |
|    | *,ITPSO .KSÓL                            | KGINAL(8)                                                           | FLG2,1PFLG3          | ,127147,140       | MPL(20)          | RE          |
|    | COMMON/AECO3/                            | ,                                                                   |                      |                   |                  | AE          |
|    | *APHO ,APHR                              | , ALPHA                                                             | , VDA                | ,GDA              | PDA              | , AE        |
|    |                                          |                                                                     | rata                 | PHI<br>VIAMB(O)   |                  | . AE        |
|    | *COSPHI ,GDPH<br>•CDOM ,CLO              | ,FK                                                                 | XLAMA(9)             | ZCSM              | ,CLGM            |             |
|    | # LPI 1:PIR                              | LIMAM LIMI                                                          | 4 . LMV              | ,CAOA             | FKH              | , AE        |
|    | +ULAM ,UL                                | , CLA                                                               | CLM                  | 1                 | -                | AE          |
|    | *CB ,CBA                                 | , CUM                                                               | 171 MAYD             |                   |                  | AE          |
|    | COMMON/BETEES/                           | FTIME, BTIME, MAX                                                   | •                    |                   |                  | RE          |
|    | ANDHEACON TOHE                           | 1 , IBUFZ                                                           | , NBFA               | , NBEB            | ,AIXA            | . RE        |
|    | AAM, GAIN*                               | GAM.                                                                | HPTA                 | ,NPTB             | , IBLKB          | RE          |
|    | * NBUFB IBUF<br>COMMON /xcodes/          | 8                                                                   |                      |                   |                  | RE          |
|    | *ITO (9),ICOR                            | (20) 111                                                            | STRI,                | .1810120 2        | 2,023 HPL,(2     | ), XC       |
|    | *JST (20)                                | NCNST                                                               | . N35                | . NS AB           | NICHB            | ', XE       |
|    | *120P , I COP                            |                                                                     | IFAR                 | , IFB             | IND              | . XC        |

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```
,ISTART
,JS
,NCASE
,N
,ISTNB
,L
,NPHB
, 1P3
   778-790123-45-678-90120-9
  C
   11 STORE NO BUFFERS USED FOR WHOLE TRAJECTORY
ALSO NO OF WORDS IN LAST BUFFER.
IF ANY DATA IN LAST BUFFER,
OURP LAST BUFFER ONTO STORAGE FILE
ENTRY ENDMR
MAXA(IFAW-38) =: IBLK1
IF(IBLK1 NE.0) ED TO 20
NBUFA(IFAW-38) = IBUF1
RAXA(IFAW-38) = MXA
RETURN
  00000
  20-
  Ç
  D(IBLK1)= PHIO
  C
   1)I-A IF BUFFER FULL , DUMP ON RANDOM FILE, ELSE RETURN IF(IBLK1.GE.MXA) 60 TO 20 RETURN
  20-
          121.
122.
123
  CCC
   III-B INCREASE SUFFER COUNTER AND DUMP SUFFER TO THE COUNTER EXCEED MAX NO. OF SUFFERS--ERROR RETURN

20 ISUF1 = ISUF1 +1
IF(IBUF1 ST NBFA-1) GO TO 30
CALL WRITMS(IFAM, B, MIXA, IBUF1)
IBLK1 = 0
RETURN
         124
125
126
127
128.
   AST3
SEP18
AST3
AST3
   30-
   RETURN
  AST3
  30 ISTART = 6
          129
130
131
132
133
134
135
137
138
139
141
142
144
145
147
148
  SEP18
SEP18
COMN
COMN
COMN
AST3
AST3
AST3
COMN
AST3
  C
C
C
   IV INTIALIZE FORWARD READ OF RANDOM FILE OR SEQ FILE IF ON SOLUTION TRAJECTORY (PRCO=1 OR 2) ENTRY BGRA IF(ITER EQ.3) REWIND 10 IBUF2 =0 GO TO 90
  96-
  C
   V FETCH TRAJECTORY DATA ENTRY ABETA
  COMM
COMM
COMM
RETAP
AST3
AST3
COMM
  C
C
C
  V-A STARTING NOMINAL CONTROL ON FILE 11 GO TO VII ELSE GET DATA FROM BUFFER IF(IND E0.1) GO TO 100 ISTN = E(IBLK2+1) PHM-E(IBLK2+2)/10040 V-B NEED CONTROL VECTOR FLAGS ON SOLUTION TRAJECTORY IF(ITER ME.3) GO TO 40 JP1=(E(IBLK2+2)-10000*IPHM)/101
  166-
  ¢
  40--
```

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```
150
                                     JP3=E(IBLK2+2) ~ 10000+IPHN -100+JP1+.5
  AST 3
                           JP3=E(IBLK2+2) ~ 10000*IPHN -100*JP1+.5

40 CONTINUE
FINE= E(IBLK2 +3)
IBLK2 = IBLK2 +3
00 50 I=1,NE0
IBLK2 = IBLK2+1
50 Y0(I) = E(IBLK2)
IBLK2 = IBLK2+1
APHO = E(IBLK2)
IBLK2 = IBLK2+1
PHO = E(IBLK2)
IF(ITER.NE 3) GO TO 70
V-C NEED TO RETRIEVE TRANSFORMED ADJOINTS ON
SOLUTION TRAJECTORY
IF(LUM EQ 0) GO TO 60
READ(10) (XL(IJ,NCN),J=1,NEQ), XLAMA(NCN),XLAMP(NCN)
60 CONTINUE
151.
152
153
154
155
156
157.
158
159
160.
161
162
163
164
   70
  60--
  AST3
     166
167. C
168.
169
                            60 CONTINUE
V-D IF ON SOLUTION TRAJ CONTROL IS UNCHANGED
APHR = APHO
PHID= PHID
   AST3
COMN
AST3
AST3
   AST3
AST3
COMN
COMN
COMN
COMN
AST3
AST3
     170
171.
172
173.
                            TO CONTINUE
IF(IBUF2 EQ.NBUFA(IFAR-38))GO TO 80
  86-
                                    V-E IF IN LAST BUFFER TEST FOR LAST WORD IN PARTIAL BUFFER ELSE TEST FOR MAX NO OF WORDS IN BUFFER (MXA) IF AT LAST WORD IN PARTIAL BUFFER SET K=4 (INDICATES END) IF(18LKZ GE.MXA) GO TO 90 RETURN
     174
175
176.
177
   90
                            80 IF(IBLK2 GE.MAXA(IFAR-38)) K=4
RETURN
     178.
179
  AST3
AST3
                            90 IBUF2 = IBUF2 +1
V-F READ IN NEXT BUFFER
CALL READMS(IFAR, E, MIXA, IBUF2)
IBLK2 =0
RETURN
     180
161
  AST3
                                AST3
COMM
AST3
IBLK2 =0
AST3
AST3
AST3
AST3
AST3
VI WRITE STARTING SOLUTION FOR QL OR NEXT CASE OF SD OR SIZING COMM
ENTRY AST0F
WRITE(11) IARC, TIME, TIMES, APHR, PHID, (VAR(I), I=1, NEQ), (XL(JJ, NCN), AST3
JULY2
VII BEAD COMM
VII BEAD COMM
VII BEAD COMM
VII BEAD COMM

                    C
     182
183
184
185
                    C
     185
186
187
188
189
190
191
   JULY28
AST3**
COMM
COMM
                                     V11
  READ STARTING NOMINAL CONTROL FROM FILE 11
     193
194
195
                          100 READ(11) ISTN,FTIME,DUM,APHR,PHID
IPHN = IPH
IF(EOF,11) 110,120
   RETAP
RETAP
NOS
  110-120-
     196
                          110 K≈4
  NO5
     197
198
                          120 RETURN
END
  NOS
AST3
```

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# SUBRØUT I NE BERØCØ

#### Subroutine BERØCØ

### Purpose

Computes total aerodynamic coefficients for all aerodynamic options. Also computes partials of coefficients with respect to state and control.

### Description

BER $\phi$ C $\phi$  is called from subroutine VT.

| FORTRAN | MATH                            | CODI | DESCRIPTION                             |       | STORA     |     |                                                                                                            |                       | USAGE                                                                         |
|---------|---------------------------------|------|-----------------------------------------|-------|-----------|-----|------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL                          | 000  | DESCRIPTION                             |       | BLOCK     | LOL | 5 U 8 R                                                                                                    | COO                   | VAR                                                                           |
| ALPHA   | άx                              | I    | Angle of attack                         | (RAD) | /AEC03 /( | 31  | BEROCO<br>BLGCON<br>BL2<br>FNTG<br>MAMECO<br>MODELA<br>MODELA<br>REU3<br>VT                                | 1<br>0<br>I           | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA |
| APHR    | α                               | I    | Angle of attack                         | (DEG) | /AEC03 /( | 2)  | AGETB3 AST3 BEROCO BLGCON GUI3A MODELA MODELB MTX3A OUT                                                    | M<br>I<br>O<br>M<br>M | APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR                  |
| CD      | c <sup>D</sup>                  | 0    | Brag coefficient                        |       | /AEC03 /( | 52) | BEROCO<br>OUT<br>VT                                                                                        | 0<br>I<br>I           | CD<br>CD<br>CD                                                                |
| CDA     | əc <sub>D</sub> /ə∝             | M    | See symbol                              |       | /AEC03 /( | 53} | BEROCO<br>VT                                                                                               | <b>19</b><br>I        | CDA<br>CDA                                                                    |
| CDM     | ac <sub>D</sub> ∕am             | 0    | See symbol                              |       | /AEC03 /( | 541 | BEROCO<br>VT                                                                                               | O<br>I                | CDM<br>CDM                                                                    |
| CDO     | $\epsilon_{D_0}$                | 1    | Drag coefficient at $\alpha=0$          |       | /AEC03 /( | 34) | BERDCO<br>EQUA3                                                                                            | I<br>I                | CD0<br>CD0                                                                    |
| CDOM    | ac <sub>Do</sub> /am            | I    | See symbol                              |       | /AEC03 /( | 35) | BEROCO<br>EQUA3                                                                                            | ĭ                     | CDOM<br>CDOM                                                                  |
| CL      | $\mathfrak{c}_{L}$              | M    | Lift coefficient                        |       | /AEC03 /( | 49} | BEROCO<br>OUT<br>VT                                                                                        | r<br>I<br>I           | CL<br>CL                                                                      |
| CLA     | $\mathfrak{c}^{L^{\mathbf{a}}}$ | M    | Lift coefficient slope                  |       | /AEC03 /( | 50) | BEROCO<br>EQUA3<br>VT                                                                                      | M<br>I                | CLA<br>CLA<br>CLA                                                             |
| CLAM    | aC <sup>r</sup> ″∖9w            | I    | See sy≋bol                              |       | /AEC03 /( | 48) | BEROCO<br>EQUA3                                                                                            | I<br>M                | CLAM<br>CLAM                                                                  |
| CLM     | ac∟∖aw                          | M    | See symbol                              |       | /AEC03 /( | 51} | BEROCO<br>VT                                                                                               | n<br>I                | CLM<br>CLM                                                                    |
| CLO     | c <sub>ro</sub>                 | I    | Lift coefficient at $\alpha=0$          |       | /AEC03 /( | 36) | BEROCO<br>EQUA3                                                                                            | I                     | CLO<br>CLO                                                                    |
| CFOM    | aC <sub>Lo</sub> ∕am            | 1    | See symbol                              |       | /AEC03 /( | 40) | BEROCO<br>EQUA3                                                                                            | I                     | CLOM<br>CLOM                                                                  |
| DEG     |                                 | 1    | Radian to angle conversion, 57.29577951 |       | /DATA /(  | 2)  | BEROCO<br>BLGCON<br>ENVPRM<br>EQUAS<br>FNTG<br>GUISA<br>MODELA<br>MIXSA<br>OUT<br>PADS1<br>SDINP<br>TRTOSZ | I                     | DEG<br>RADD<br>RADD<br>RADD<br>RADD<br>RADD<br>RADD<br>RADD<br>RAD            |
| FK      | k                               | 1    | Induced drag coefficient                |       | /AEC03 /( | 37) | BEROCO<br>EQUA3                                                                                            |                       | FK<br>FK                                                                      |
| FKM     | ak/am                           | I    | See symbol                              |       | /AEC03 /( | 47) | BEROCO<br>EQUA3                                                                                            |                       | FKM<br>FKM                                                                    |

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| FORTHAN<br>GYMBOL | MATH<br>Symbol | CODE      | DESCRIPTION                                                       | S TORAG<br>Block | E<br>LOC | 2088 COD<br>2088 COD                                                       |                                                      |
|-------------------|----------------|-----------|-------------------------------------------------------------------|------------------|----------|----------------------------------------------------------------------------|------------------------------------------------------|
| 1F0B              |                | =         | or adjoint integration flag<br>1 means forward<br>2 means adjoint | /xcodes/(        | 178)     | ACCEL I<br>BEROCO I<br>BLYNE I<br>EQUAS I<br>IMPUL I<br>SPLYNE I<br>TOPM O | IFOB<br>IFOB<br>IFOB<br>IFOB<br>IFOB<br>IFOB         |
| JAER              |                | I Aerodyn | amic model option flag                                            | /ARCDAT/(        | 9)       |                                                                            | JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER |
| MACH              | M              | I Mach nu | mber                                                              | /GENF /(         | 307)     | BEROCO I<br>ENVPRM I<br>EQUAS M<br>OUT I                                   | MACH<br>MACH<br>MACH<br>MACH                         |

```
BEROCO
COMM
COMM
ARCDAT
   SUBROUTINE BERDCO
 1234567890
                            CCC
  CALCULATES AERO COEFFICIENTS
   COMMON/ARCDAT/
*SREF ,EJ
  DTNC
OMAX
PHMAX
MAEF
MUDA
ZE
REMAX
   DTPI
GMAX
MAEA
MAES
MUDB
   EJ
IMODE
HDMAX
MAEC
  , THULT
   JAER
JAER
SMUUT
MAED
MXCG
ZCGR
RHOB
   JPRO
ALFMAX
MAEE
MZCG
XE
QMULT
  *IATM
*XLMAX
*MAEB
   #MT
  EQUIVALENCE
COMMON/SENF/
**OMS(20) 0
**A(*),9) #
**BTS | R
**VNO | R
**SVSO | T
**TIP1(20) | T
**TIP1(20) | T
**TIPPR | L
**AE | F
**URTER | L
   GENF
GENF
  , WBC(20)
, DTP
, QS
, CS
, SUMSQ
, TR(9)
, U
, OMP
, TBU(20)
, MACHY
   ,TOL(9) ,SVAR(10) ,COTI(9,9) ,DCON(9) ,BPSQ ,RO ,CSR ,VNR ,TOP ,TOS
   GENF
  TOP
DIF(20)
DIF(2G)
TAX
FPD
LIFTY
DRAGY
DB
ULFTY
XACGA
CDE
ZCG
  TIME
TIME
TBURN
MACHR
  DRAGR
ISP
ULFTR
XMCGM
DELTAE
  DRAGA
ISPF
ULFTA
CODAE
,SID
  *LIFTR
     DBR
ULFT
XMCGR
CALPHA
XCG
  , XKP
   . GAMMAD .
   . XKG
  , XK1
, XK1D
, XK1V
, XK1P
, XK10
, XK1M
, PR
  , XK2
, XK2D
, XK2V
, XK2P
, XK2D
, XK2M
, PO
  , xk3
, xk3D
, xk3V
, xk3P
, xk3O
, xk3A
, xk3A
   GENF
SENF
SENF
   MACH, MÁCHR,
  XCODES
   xcodes
xcodes
xcodes
xcodes
xcodes
xcodes
xcodes
xcodes
   XCODES
XCODES
XCODES
XCODES
XCODES
AECO3
A
   APHR
COSA
GDPH
CLO
CMA
CL
   ALPHA
PHIG
PDPH
FK
CMAM CMM
CLA
COM
  *APHO
*SINA
*COSPHI
*CDOM
*CLAM
*CLAM
   , VDA
, PHID
, XLAMA(9)
, XCSM
, CMO
, CLM
  ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
  ,PDA
,SINPHI
,CDO
,CLOM
,FKM
  COMMON/DATA/
  COMMON/DATA/

*FI RAD RDI

*FTHM CAR JOE

EQUIVALENCÉ(RAD, DEG)

IF(JAER .ED. 2) 60 TO 50

I BIVARIATE DATA TE

CL = CLO + ALPHA*CLA

CD = CDO + FK*CL**2
   ,RD1
,JOP1
   *PI
*FTNM
   ,UMF
,JDP3
  ,TMPF
,JOP4
   ,5C
,J0P2
  BEROCO
  50-
   COMN
BEROCO
BEROCO
                               C
  TEST
```

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```
SERDED
COMN
COMN
BERDED
BERDED
BERDED
BERDED
COMN
COMN
                                   CDA = 2.*FK+CL+CLA
76
77.
78.
80.
81.
82.
83
84
85.
86.
87.
                                  11 ON FORWARD TRAJ. SKIP PARTIALS IF(IFOB.EQ.1) RETURN CLM = CLOM + ALPHA*CLAM CDM = CDOM + CL*(FKM*CL + 2.*FK*CLM) RETURN
                        III BIVARIATE AERO INTERPOLATION

50 CALL BLYNE(APHR ,MACH,CL)

CLA = CLA*DEG
CDA = CDA*DEG
RETURN
END
   BEROCO
BEROCO
BEROCO
BEROCO
```

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# SUBRØUT I NE BGET3

#### Subroutine BGET3

#### Purpose

This subroutine retrieves all adjoint data during forward trajectory. It has an initialization entry point called BGRB and a main entry point, BGET.

#### Description

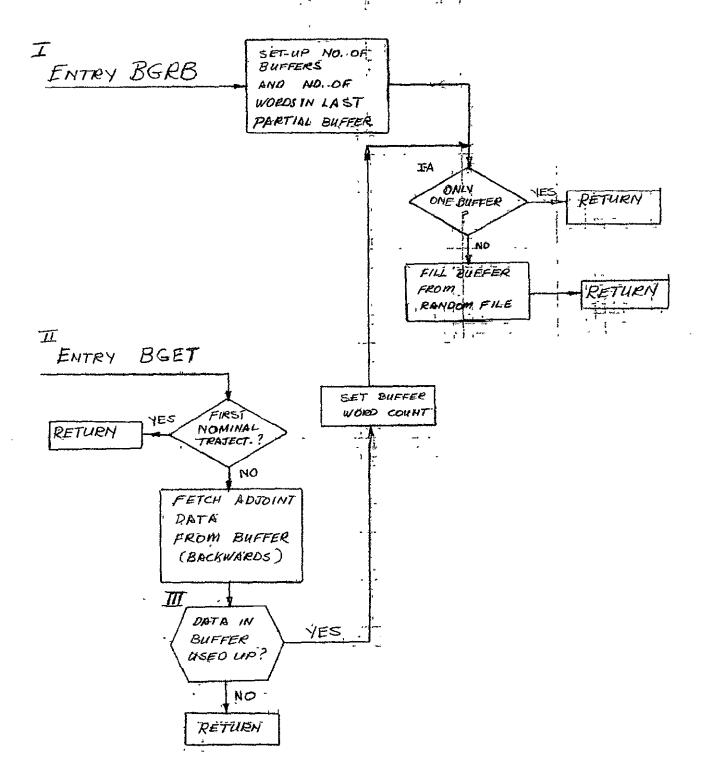
Entries BGRB and BGET are called from various routines in the module.

BGET and BGRB are called from FNTG.

BGET is called from GETIT.

BGRB and BGET are called from TRAN3.

### SUBROUTINE BEET3.



| FORTHAN<br>SYMBOL | MATH<br>Symbol | CODE | DESCRIPTION                                                                                              | STORAG<br>BLOCK | LOC  | <u>SUARDUI</u><br>SUBH I                                                                                                     |                                      |                                                                               |
|-------------------|----------------|------|----------------------------------------------------------------------------------------------------------|-----------------|------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------------------------------------------------|
| A                 | A              | 0    | Control integral matrix                                                                                  | /GENF /(        | 109) | ADEQ3A<br>ADICB3<br>BGET3<br>BNTG3<br>MTX3A<br>PAYO2<br>SDINP<br>TRAN3                                                       |                                      | A A A A A A A A A                                                             |
| IBLKB             |                | M    | Index of adjoint data buffer where either last word was stored or retrieved.                             | /RETREV/(       | 18)  | BGET3                                                                                                                        | M                                    | IBLKB                                                                         |
| IBUFB             |                | M    | Counts aumber of buffers of adjoint data that have either been stored or retrieved as solution progress. | /RETREV/(       | 20)  | BGET3<br>BST03                                                                                                               | M                                    | IBUFB<br>IBUFB                                                                |
| IFB               |                | I    | File where adjoint solution is stored                                                                    | /XCODES/(       | 140) | BGET3<br>BST03<br>TOPM                                                                                                       | I<br>I<br>0                          | IFB<br>IFB<br>IFB                                                             |
| IND               |                | I    | Flag indicates whether on first nominal trajectory (INO=1)                                               | /XEODES/(       | 141) | AST3<br>BGET3<br>FNTG<br>GUI3A<br>MTX3A<br>PROPIN                                                                            | I<br>M<br>I<br>I                     | IND<br>IND<br>IND<br>IND<br>IND<br>IND                                        |
| MAXB              |                | I    | Number of mords in last stored partial buffer of adjoint data. Corresponds to random file 41.            | /RETREV/(       | 5)   | BGET3<br>BST03                                                                                                               | I<br>M                               | MAXB<br>MAXB                                                                  |
| mIXB              |                | I    | Maximum number of words in adjoint data buffer = 3000.                                                   | /RETREV/(       | 13)  | BGET3<br>BSTO3<br>SDINP<br>TOPM                                                                                              | I<br>I<br>I<br>O                     | MIXB<br>MIXB<br>MIXB<br>MIXB                                                  |
| MXB               |                | I    | Index of last stored word in full buffer of adjoint data.                                                | /RETREV/(       | 15)  | BGET3<br>BST03<br>SDINP                                                                                                      | I<br>I<br>O                          | MXB<br>MXB<br>MXB                                                             |
| NBUFB             |                | I    | Number of buffers of adjoint data stored on last adjoint solution.                                       | /RETREV/(       | 19)  | BGET3<br>BST03                                                                                                               | 100                                  | NBUFB<br>NBUFB                                                                |
| NCNST             | n              | I    | Number of problem constraints                                                                            | /XCODES/(       | 132) | BGET3<br>BST03<br>CON3<br>PAY02<br>SOINP<br>SUMS<br>TEST<br>TOPM<br>TRAN3                                                    | I<br>I<br>I<br>I<br>I<br>I<br>I<br>I | NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST |
| NEQ               |                | 1    | Number of integrated states                                                                              | /xcodes/(       | 162) | ADICBA<br>ADICBA<br>ADICBA<br>ADICBA<br>AGETBA<br>AGETA<br>BSTOB<br>MTX3A<br>OUT<br>SDERB<br>SDERB<br>SDINP<br>TOPM<br>YREF3 | I                                    | N N N N N N N N N N N N N N N N N N N                                         |
| NPTB              |                | 1    | Number of words stored at each adjoint solution time point.                                              | /RETREV/(       | 17)  | B GET3<br>SDINP                                                                                                              | I<br>M                               | NPTB<br>NPTB                                                                  |

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| GRIBAN<br>Symbol | MATH<br>54MB01                  | LODF       | DESCRIPTION                                                             | 810CK   | RA JE<br>LOC |                                                      | BA C                                                 |                       | USAGE<br>VAR                                                                    |
|------------------|---------------------------------|------------|-------------------------------------------------------------------------|---------|--------------|------------------------------------------------------|------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------|
| ΧĹ               | y <sub>*</sub> ι <sub>υ</sub> າ | n <i>0</i> | Matrix of adjoint variables                                             | /STATE3 | /( 246       | ADI<br>ADI<br>AST<br>BGE<br>BST<br>MTX<br>OUT<br>STA | C83<br>C3A<br>D3A<br>3<br>T3<br>O3<br>3A<br>U<br>RL3 | M<br>M                | XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>X |
| XLAMA            | $V_{\Phi^1 \mathfrak{Q}^1}$     |            | Impulse response function column vector associated with angle of attack | /AECO3  | /( 16        | ) ADE<br>ADI<br>AST<br>BGE<br>BST<br>MTX<br>TRA      | C3A<br>3<br>T3<br>D3<br>3A                           | 0<br>0<br>0<br>M<br>1 | XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA            |
| XLAMP            | $\Lambda^{\Psi_1\Omega_3}$      |            | impulse response function column vector associated with bank angle      | /AECO3  | /( 25        | ADE<br>ADI<br>AST<br>BGE<br>BST<br>MTX<br>TRA        | C3A<br>3<br>T3<br>03<br>3A                           | 0<br>0<br>0<br>M<br>I | XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP                     |
| Z                |                                 | I A        | Adjoint storage buffer                                                  | /BGET3  | /(*          | ) BGE                                                | T3                                                   | I                     | Z                                                                               |

| C | SUBROUTI             | NE BGETS                                                 |                                 |                       |                   |                                   |    | BSET3<br>COM4 |
|---|----------------------|----------------------------------------------------------|---------------------------------|-----------------------|-------------------|-----------------------------------|----|---------------|
|   |                      | E ADJOINTS ,                                             | IMPULSE RE                      | SPONSE FUNCT          | A BAR HGI         | MATRIX                            |    | COMM          |
| C | FOR TR               | AJECTORY CON                                             | TROL AND PA                     | RAMETER CALI          | CULATIONS         |                                   |    | COAN          |
|   | COMMON/R             | ETREV/ FTIME                                             | , DIINE, MAKA                   | ( Z ) , MHAB          |                   |                                   |    | RETRE         |
|   | +NBUFA(2)            | TRUET                                                    | ,1BUF2                          | NBFA                  | NBFB              | HIXA                              | _  | RETRE         |
|   | *#IXB                | MXA                                                      | MXB                             | NPTA                  | NPTB              | IBLKB                             | •  | RETRE         |
|   | + NBUFB              |                                                          | ,                               | •                     | •                 |                                   |    | RETRE         |
|   | COMMON/S             | TATE3/                                                   |                                 |                       |                   |                                   |    | STATE         |
|   | *VAR(14)             | DVAR (14                                                 | ), VARL (99)<br>, YDS (20,9)    | BVARL(99)             | ,Y0(9)            | ,SVY(10)<br>,SAVBP(15)<br>,0C0#02 | ,  | STATE         |
|   | +XL(9,9)<br>+SINPS1  | ,cospsi                                                  | ,SINRHO                         | , COSERHO             | SINSAM<br>OCORHO  | ,SAUDELISI                        | ,  | STATE         |
|   | +SVBV (              | 9),OMESA                                                 | OMEGA2                          |                       | _                 | , countr                          | ,  | STATE         |
|   | +VDV                 |                                                          | .ROV                            | , ADV                 | ,P04              | ,20¥                              |    | STATE         |
|   | *85A                 | . VDG                                                    | .606                            | , 405                 |                   | กลร                               | ;  | STATE         |
|   | *UD6                 | , VOH                                                    | GDR                             | . MBK                 | PHE               | , OOR                             | ,  | STATE         |
|   | #UDR                 | , VDR                                                    | . 508                           | , ADA                 | POA               | . VCP                             | ,  | STATE         |
|   | +GDP<br>+PDB         | , PDP<br>, UDD                                           | , ODP<br>HTDV                   | HTDR                  | , voa             | , and                             | ,  | STATE         |
|   |                      | , MDY, MDR                                               | , n194                          | , 13 I DH             |                   |                                   |    | STATE         |
|   | REAL MOM<br>COMMON/S | TATES!                                                   |                                 |                       |                   |                                   |    | STATE         |
|   | +SIN2RO              | , COS2RO                                                 | , COS26M                        |                       |                   |                                   |    | STATE         |
|   | COMMON/A             | EC03/                                                    | -                               |                       |                   |                                   |    | AEC03         |
|   | <b></b> APH0         | , APHR                                                   | , ALPHA                         | , VDA                 | , 60a             | PBA                               | ,  | AEC03         |
|   | ¥SINA<br>≉COSPHI     |                                                          | PHIO<br>POPH                    | PHID<br>XLAMA(9)      | ,PHI<br>,XLARP(9) | ,SIMPHI<br>,CDO                   | ,  | AEC03         |
|   | +CBOM<br>+CDSFN1     | , SDPH<br>, CLO                                          | ,FK                             | ,XC6M                 | LEGM              | ,CLGM                             | ,  | AEC03         |
|   | *CM                  | CBV                                                      | "CMAM "CHR                      | CNG                   | CACH              | ,EKA                              | ,  | AEC03         |
|   | +CLAM                | ,či                                                      | CLA                             | , CLA                 | , 0.1011          | ,                                 | ,  | AEC03         |
|   | *CD                  | , CDA                                                    | CDM                             | ,                     | •                 |                                   |    | AEC03         |
|   | COMMON /             | XCÓDES/                                                  |                                 |                       |                   |                                   |    | XCODE         |
|   | +ITO (               | 9),ICOR (20                                              | ),ITI_                          | INTE                  | , JSTB( 20,2      | 2), JFH (20,2)                    | ١, | XCODE         |
|   | *121 (5              | u 1                                                      | NCMST                           |                       | HSAB              | NICHB                             | ,  | XCOBE         |
|   | *120P                | , I COP                                                  |                                 | IFAN                  | .116              |                                   | ,  | XCODE         |
|   | *10PEN<br>*ITCT      | IPH<br>ITER                                              | ISPH<br>IVAR                    | ISST,<br>JK           | JARC<br>JPS       | ISTART                            |    | XCODE         |
|   | +KDP                 | , KPST                                                   | ,K                              |                       | , HAD             |                                   | ,  | XCODE         |
|   | *NCN                 | NEOB                                                     | NED                             | มกอ                   | HEM               | ×                                 | ,  | XCODE         |
|   | +NST                 | .IPST                                                    | IPRINT                          | TCTM                  | . IPAN            | ISTAB                             | ,  | XCGDE         |
|   | <b>#IPHNB</b>        | IBLKI                                                    | ,IBLK2                          | ,ÎSTÔP                | ISTPP             | L                                 | :  | XCODE         |
|   | *IFOB                | , NB                                                     | LB                              | . PIB                 | . 4646            | _erno                             | ;  | XCODE         |
|   | *NCTIN               | ,NEOF ,ILA                                               | L, 9R9L, (8)8                   | GII,MTT,MPI/          | 4(ZG),JP1,J       | 165,763                           |    | XCODE         |
|   | COMMON/6<br>+OMG(20) | OMPD/30 3                                                | 1 WARDED                        | T01/03                | ,5VAR(10)         | , MBC( 26 )                       |    | SENF          |
|   | *A(9,9)              | ,0MGP(20,2<br>,ACOH(9)                                   | , BCON(9)                       | ,TOL(9)<br>,COTI(9,9) | ,BCON(9)          | , BTP                             | ,  | GENF          |
|   | +DTS                 | - 41)                                                    |                                 |                       | ,0                |                                   | ,  | BENF          |
|   | *R                   | . HF                                                     | MAUH                            |                       | RO                |                                   | ,  | GENF          |
|   | +VNU                 | 200                                                      |                                 | CSR<br>Top            | , VNB             | . 30034                           | ,  | SENF          |
|   | *5V50                | TIMEPH                                                   | TIMES<br>) DIS(20)              | TOP                   | ,TOS              |                                   | ,  | SENF          |
|   | +151(20)             | ,TPH (20                                                 | ),015(20)                       | DIF(20)               | , [               | N                                 | ,  | GENF          |
|   | *TLP1(20) *TIMPR     |                                                          |                                 | . 0151(261            | TIME              | , อหP<br>, TBป( 20 )              | ,  | GENF          |
|   | +11rrn<br>+AE        | ,LIFT                                                    | DRAG<br>FPOLD                   | TAX<br>FPB            | TBURN             | MACHY                             | ,  | GENF          |
|   | *0ñ                  | , ov                                                     | FVAC                            | LIFTY                 |                   | , nacat                           | ,  | GENE          |
|   | <b>≠LIFTR</b>        | LIFTA                                                    |                                 | DRAGV                 | DRASE             | .DHASA                            |    | GENF          |
|   | •                    | LIFTE                                                    | DBR                             | , DB                  | 150               | ÍSPE                              | •  | SEAF          |
|   |                      |                                                          | +13 <b>5</b> − 1                |                       | _ULFTR            | (1) F 1 25                        | ;  | SENF          |
|   | *XMCG                | , XMCGV                                                  | , XMCGR                         | XMCGA                 | XACSM             | LUUNE                             | ,  | SENF          |
|   | +CULFT<br>+COD       | ,CT                                                      | CALPHA                          | , CUE                 | DELTAE            | ,SID                              | ,  | SENF          |
|   | COMMON /             | SIDAE<br>GENF /                                          | ,xcs                            | , ZCE                 | ,xj               |                                   |    | SENF          |
|   | *XJV                 | GENF /<br>,XJR                                           | , GH                            | , GAMMAD              | .XKG              | , XKP                             |    | GENF          |
|   | *FRATED              | 1RATER                                                   |                                 | , 0411110             | •                 | -                                 | ,  | SENF          |
|   | *P1                  | P2                                                       | ,P3                             | , XK1                 | XK2               | ,XK3                              |    | GENF          |
|   | *XK1T                | . XK21                                                   | XKST                            | 4K ) D                |                   | XX.38                             | :  | GENF          |
|   | +XK1A                | 7576                                                     | 78.40                           | YKIW                  | 2628              | XXXV                              | ;  | SENF          |
|   | *XK1G                |                                                          |                                 | XILI                  |                   |                                   |    | SENF          |
|   | *XK1R                | . X K 7 R                                                |                                 | , XNIU                | 1870              |                                   | ,  | SENF          |
|   | *XK1U<br>≠PV         | , XK2U                                                   |                                 | XKIM                  | XKZN              | - AK-173                          | ,  | SENF          |
|   | REAL LI              | FIR , LIFT ,                                             | (TETA LIST                      | PR                    | ,PO MACH,         | DPDY(3,8)                         |    | GENF<br>SENF  |
|   | = ISP IS             | FTR LIFT<br>PF MACHY LI<br>N TPHI(10) T<br>NCE(TLPI, TPH | , PP<br>LIFTA LIFT<br>FTV IRATE | n,                    | пнып,             | magna,                            |    | FRAT          |
|   | DIMENSIO             | N TPH1(10).T                                             | STICIO                          | -                     |                   |                                   |    | SENF          |
|   |                      |                                                          |                                 |                       |                   |                                   |    |               |

20-0CT 72 6.01-46

```
BGET3
COMN
COMN
COMN
BGET3
BGET3
BGET3
BGET3
     76.
77.
78.
79.
80.
81.
82.
83.
                         DIMENSION Z(3000)
                        I INITIALIZE, SET-UP WO.DF BUFFERS AND NO.DF WORDS IN LAST (PARTIAL) BUFFER ENTRY BGRB KK= NCNST+1 IBLKB = MAXB +1 IBUFB = NBUFB+1 GD TO 20
  20-
                  85.
                    10 IBLKB = MXB +1
   BGET3
86.
87.
88.
890.
91.
923.
945.
961.
98.
1003.
1103.
1104.
1104.
1114.
1114.
1116.
              C
III IF DATA IN BUFFER USED UP LOAD BUFFER, ELSE RETURN IF(IBLKB.LE.1) GD TO 10 RETURN FOR
  BGET3
COMN
COMN
BGET3
BGET3
BGET3
   10-
```

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### SUBRØUTINE BLGCØN

#### Subroutine BLGCØN

#### Purpose

Subroutine BLGC $\emptyset$ N solves for the in-plane control vector, w, and also during the adjoint solution computes the explicit and complete partials of the control vector with respect to state and control. The method of solution for the in-plane control vector is described in Section 9.2 of Volume I. The detailed logic flow description of this subroutine may be found in subroutine ALGC $\emptyset$ N which is the Quasi-linearization module version of BLGC $\emptyset$ N.

#### Description

BLGCØN is called both during the forward trajectory by subroutine MODELA and during the adjoint solution by subroutine MODELB.

| FORTRAN | MATH           | Cone | DESCRIPTION                                                             |       | STORAG     |      | SUBROUTIN                                                                                                                          |                                                                              |
|---------|----------------|------|-------------------------------------------------------------------------|-------|------------|------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL         |      | DESCRIPTION                                                             |       | BLOCK      | LDC  | SUBR COD                                                                                                                           | E VAR                                                                        |
| ALPHA   | α              | M    | Angle of sttack                                                         | (RAD) | /AECO3 /(  | 3)   | BEROCO I<br>BLGCON M<br>BLZ I<br>FATG I<br>MAMECO I<br>MODELA M<br>MODELB O<br>REU3 I                                              | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA         |
| APHR    | α              | 0    | Angle of attack                                                         | (DEG) | /AEC03 /(  | 2)   | AGETB3 O<br>AST3 M<br>BEROCO I<br>BLGCON O<br>GUI3A M<br>MODELA I<br>MODELB I<br>MTX3A O<br>OUT I                                  | APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR                 |
| DELTAE  | <sup>8</sup> E | M    | Engine gimbal deflection angle                                          | (RAD) | /GENF /(   | 554) | BLGCON M<br>ELI I<br>OUT I<br>REU3 O<br>VT I                                                                                       | DELTAE<br>DELTAE<br>DELTAE<br>DELTAE<br>DELTAE                               |
| DET     |                | u    | Determinant                                                             |       | /BLGCON/(+ | . )  | BLGCON W                                                                                                                           | DET                                                                          |
| BP      | Δ₩             | 1    | Corrections to in-plane control vector                                  |       | /BLGCON/(* | •    | BLGCON I                                                                                                                           | DP                                                                           |
| DPDY    | 9m\9À          | I    | Matrix of partials of in-plane control vector state                     | prt   | /GENF /(   | 6101 | ACCEL I<br>BLGCON I<br>OUT I                                                                                                       | DPDY<br>DPDY<br>DPDY                                                         |
| ISTART  |                | 0    | Initialization and divergance flag                                      |       | /XCODES/(  | 147) | AST3 O<br>BLGCON O<br>BLYNE O<br>FNTG I<br>MODELA O<br>PROPIN O<br>REUS I<br>TEST M                                                | ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART |
| P       |                | M    | First element in in-plane control vector.<br>Corresponds to thrust      |       | /GENF /(   | 569) | BLGCON A<br>BLGCON A<br>OUT 1                                                                                                      | Р<br>Р1<br>Р1                                                                |
| P1      |                | M    | First element in in-plane control vector.<br>Corresponds to thrust      |       | /GENF /(   | 569) | BLGCON M<br>BLGCON M<br>OUT I                                                                                                      | P<br>P1<br>P1                                                                |
| P2      |                | P    | Second element in in-plane control vector.<br>Corresponds to deflection |       | /GENF /(   | 570) | BLGCON M                                                                                                                           | P2                                                                           |
| Р3      |                | M    | Third element in in-plane control vector, corresponds to $\alpha$       |       | /GENF /(   | 571) | BLGCON M                                                                                                                           | P3                                                                           |
| RAD     |                | 1    | Radian to angle conversion, 57.29577951                                 |       | /DATA /(   | 2)   | BEROCO I<br>BLGCON I<br>ENVPRM I<br>EQUAS I<br>FNTE I<br>GUISA I<br>MODELA I<br>MTX3A I<br>OUT I<br>PADS1 D<br>SDINP I<br>TRTOSZ I | DES<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD           |

| ORTRAN | MAIH   | CODE | DESCRIPTION                                                                  |        | QRA: |      | SUBROUTINE USAGE                                                                                                                                 |
|--------|--------|------|------------------------------------------------------------------------------|--------|------|------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL | SYMBOL |      | DE SOUTH LION                                                                | BLOCK  | •    | LOC  | SUBR CODE VAR                                                                                                                                    |
|        | T      | M    | Thrust (LBS)                                                                 | / GENF | /(   | 411) | ACCEL I T BLGCON M T BL4 I T BL6 I T BL7 I T BL8 I T EL2 I T EQUAS O T FH1 I T FH2 I T FH4 I T IMPUT I T PROPB O T PROPIN O T REUS O T SOERS I T |
| XK1    |        | 1    | First control vector governing equation value corresponds to error in thrust | /GENF  | /(   | 572) | BLGCON I XK1<br>FH1 0 XK1<br>FH2 0 XK1<br>FH3 0 XK1<br>FH4 0 XK1<br>MODELA I XK1                                                                 |
| XK1A   |        | I    | Partial of governing equation wrt state or control vector component          | /GENF  | /(   | 581) | BLGCON I XK1A<br>FH3 M XK1A                                                                                                                      |
| XK1D   |        | 1    | Partial of governing equation brt state or control vector component          | /GENF  | /(   | 578) | BLGCON I XK1D<br>FH3 M XK1D                                                                                                                      |
| XKIT   |        | 1    | Partial of governing equation ært state or control vector component          | /GENF  | /(   | 575) | BLGCON I XK1T<br>FH1 0 XK1T<br>FH2 0 XK1T<br>FH3 M XK1T<br>FH4 0 XK1T<br>MODELA 1 XK1T                                                           |
| XK1V   |        | ı    | Partial of governing equation art state or control vector component          | /GENF  | /(   | 584) | BLGCON I XK1V<br>FH3 M XK1V<br>FH4 O XK1V                                                                                                        |
| XKZA   |        | 1    | Partial of governing equation wrt state or control vector component          | /GENF  | /ι   | 582) | ACCEL I XK2A<br>BLGCON I XK2A<br>EL2 O XK2A                                                                                                      |
| XK20   |        | 1    | Partial of governing equation wrt state or control vector component          | /GENF  | /(   | 579) | ACCEL 1 XX2D<br>BLGCON 1 XX2D<br>EL1 0 XX2D<br>EL2 0 XX2D                                                                                        |
| XKZT   |        | I    | Partial of governing equation ort state or control vector component          | /GENF  | /(   | 576) | BLGCON I XK2T<br>EL2 0 XK2T                                                                                                                      |
| XK3A   |        | I    | Partial of governing equation ært state or control vector component          | /GENF  | /(   | 583) | BLGCON I XK3A<br>BL2 O XK3A<br>BL3 O XK3A<br>BL4 O XK3A<br>BL5 M XK3A<br>BL6 O XK3A<br>BL7 O XK3A<br>BL8 O XK3A                                  |
| XK30   |        | 1    | Partial of governing equation art state or control vector component          | /GENF  | /(   | 580) | BLGCON I XK3D<br>BL4 0 XK3D<br>BL6 0 XK3D<br>BL7 0 XK3D<br>BL8 0 XK3D                                                                            |
| хкэт   |        | 1    | Partial of governing equation wrt state or control vector component          | /GENF  | /(   | 577) | BLGCON I XK3T<br>BL4 0 XK3T<br>BL6 0 XK3T<br>BL7 0 XK3T<br>BL8 0 XK3T                                                                            |

BLGCOM

```
SUBROUTINE BLGCON(JP1, JP2, JP3)
COMMON/XCODES/IXCOD(146), ISTART
DIMENSION DP(3), P(1)
EQUIVALENCE (F,P1), (XKY, XKIV), (XKPI, XKPIL1)
COMMON/GENF/
*OMG(20), OMGP(20,2), VARQ(9), TOL(9)
*A(9,9), ACON(9), BCON(9), COTI(9,9),
*DTS, DT, G, DP50
*B RE, MACH, PA
  PO14
PO14
BLGCON
BLGCON
         NF/P1),(XKY,XKIY),
OMGP(20,2),VARG(9),
ACON(9), BCON(9),
OT GACH
PAR MACH
PAR MACH
PAR HOR
TIMEPH TIMES
TPH (20),DIS(20),
TIS1 (20),DIS(20),
TIS1 (20),DIP(20),
LIFT DRAG
FP FPOLD
QV FVAC
LIFTA DBR
ULFT
  TOL(9) SVAR(10)
COTI(9,9) DCON(9)
DPS9 AD
CSR VMR
TOP TOS
DIP(20) T
DIS1(20) TIME
TAX TBURN
FPO MACHR
LIFTY DRAGY DRAGR
DB ULFTY ULFTR
XMCGA XCGM
CDE XJ
  GEENTF
GEENTF
GEENTF
GEENTF
GEENTF
GEENTF
GEENTF
GEENTF
   WDC(20)
DTP
QS
CS
SUMSQ
TR(9)
W
OMP
TBU(20)
MACHY
   +DTS

+R

+VNU

+SVSQ

+TST(20)

+TLP1(20)

+TIMPR

+AE

+QR

-11FTP
   DRAGA
ISPF
ULFTA
CODAE
SID
  GENF
GENF
GENF
GENF
GENF
GENF
   *LIFTR
  DBR
ULFT
XMCGR
CALPHA
XCG
  , GARRAD
  , XKP
  , XKG
   GENF
GENF
GENF
GENF
GENF
GENF
GENF
   XK1
XK1D
XK1V
XK1P
XK1D
XK1D
XK1D
  , XK3
, XK3D
, XK3V
, XK3P
, XK3D
, XK3M
, DPDY(3,
   XK2
XK20
XK2V
XK2P
XK20
XK2N
PO
  MACH,
   MÁCHR,
   FRAT
                                   SENF
AECO3
   ALPHA
PHIO
POPH
FK
CMAM CMM
CLA
CDR
  AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
  , VDA
, PHID
, XLAMA(9)
, XCGM
, CMO
, CLM
   ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
   ,PDA
,SINPHI
,CDO
,CLOM
,FKM
   AECO3

STATE30

   ATE3/

DVAR (14), VARL (99)

YOP(20,9), YOS (20,9),

COSPSI SINRHO

) OMEGA OMEGA2

GDV RDV

VDG GDR

YDM GDR

YDM GDR

YDM GDR

YDM GDM

PDP ODP
  DVARL(99)
COSGAM
,COSRHO
  ,SVY(10)
,SAVBP(15)
,OCORO2
   ,YO(9)
,SINGAM
,OCORHO
                                     STATE30
STATE30
STATE3D
  BLGCON
BLGCON
BLATA
DATA
PO14
PO14
PO16
BLGCON
BLGCON
BLGCON
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BLGCON
BLGCON
D
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```
100 CALL VINOP
GO TO (101,102,103,104),JP1
   BLGCON
FIXED
  101-102-103-104
   78
79
                                 101 CALL FH1001
GO TO 110
   BLGCON
   110-
   BLGCON
   80
81
                                 102 CALL FH2001
60 TO 110
   BLGCON
   110
   BLGCON
  82
83
                                103 CALL FH3001
GO TO 110
   BLGCON
  FIXED
  110-
                                 104 CALL FH4001
   84
  FIXED
   BLGCON 111-112-
                                 110 GO TO (111,112) ,JF2
   85
   86
87
                                 111 CALL EL1001
60 TO 120
   BLGCON
BLGCON
   120--
   88
                                 112 CALL EL2001
   BLGCOM
                                  120 GO TO (122, 123, 124, 125, 126 , 127, 128 , 129 ), IP3
    89
   BLGCON
  123-124-125-126-127-128-129-
                                 122 CALL BL2001
60 TO 300
    90
91
   PO14
BLGCON
  300
    92
93
                                 123 CALL BL3001
GO TO 300
  BLGCON
BLGCON
   94
95
                                124 CALL BL4001
GO TO 300
   BLGCON
  300-
   BLGCON
    96
97
   BLGCON
BLGCON
                                125 CALL BL5001
60 TO 300
   300-
   98
99
                                126 CALL BL6001
GO TO 300
   BLGCON
   BLGCON
   300
100
101
                                 127 CALL BL7001
GO TO 300
   BLGCON
   BLGCON
  300
102
103
                                 128 CALL BLB001
60 TO 300
   BLGCON
BLGCON
   300
                                 129 CALL BL9001
104
   BLGCON
105
106
   BLGCON
BLGCON
                                 300 ITR = ITR +1
IF(ITR GT 20) GO TO 3025
   3025-
                                301 CONTINUE
DET = XK2T=(XK1D+XK3A - XK1A+XK3D) + XK2D+(XK1A+XK3T - XK1T+XK3A)
+ + XK2A+(XK1T+XK3D - XK1D+XK3T)
IF(ABS(DET) GT 1 E-20) GB TO 3011
107
108
109
110
   BLGCON
BLGCON
BLGCON
BLGCON
  3011-
111
112
                             3025 ISTART=6
RETURN
   BLGCON
BLGCON
                              3011 CONTINUE
   BLGCON
113
                                3011 CONTINUE

XP711 = (XX2D*XX3A - XK2A*XX3D)/DET

XKP121 = (XK2A*XX3T - XK2T*XX3A)/DET

XKP131 = (XK2T*XX3D - XK2D*XX3T)/DET

XKP131 = (XK1*XX3D - XK2D*XX3T)/DET

XKP122 = (XX1*XX3A - XK1A*XX3T)/DET

XKP132 = (XX1*XX3A - XK1A*XX3T)/DET

XKP133 = (XK1D*XX3T - XK1*XX3D)/DET

XKP133 = (XK1D*XX3T - XK1*XX2D)/DET

XKP133 = (XK1*XX2T - XK1*XX2D)/DET

XKP133 = (XK1*XX2T - XK1*XX2A)/DET

GO TO JSWTCH

302 CALL MATMLT(OP, XKP111, XK1, 3, 3, 1)

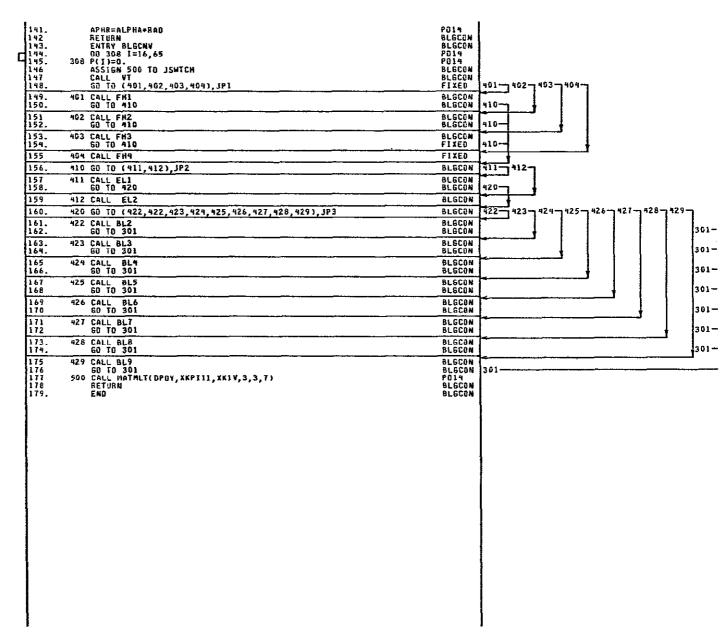
SUM = 0
  BLGCON
BLGCON
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BLGCON
BLGCON
BLGCON
BLGCON
BLGCON
BLGCON
BLGCON
111678-
111678-
111201223-
11201223-
11201223-
11201223-
11201223-
1120123-
1120123-
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                                302 CALL MATRITOP, XKPIII, XKI, 3
SUM = 0
00 306 I = 1, 3
BIV = P(I)
IF(ABS(DIV) LT 01) DIV=.01
306 SUM = SUM + ABS(DP(I)/DIV)
IF(SUM LE I.E-12) GO TO 307
CALL MATAOD(P, P, DP, 3, 1)
I = P1
DELTAE = P2
APPHA = P3
APPHE-ALPHA-RAD
GO TO ISWICH
   BLGCON
BLGCON
BLGCON
PO14
   BLGCON
  BLGCON
BLGCON
BLGCON
BLGCON
   307-
  BLGCON
PO14
BLGCON
                                  307 CALL MATADO(P, P, DP, 3, 1)

1 = P1

DELTAE = P2

ALPHA = P3
131
138
139
140
   BLGCON
BLGCON
   BLGCON
BLGCON
```

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### SUBRØUT I NE BLYNE

#### Subroutine BLYNE

### Purpose

This routine interpolates bivariate tables.

| ORTRAN | MATH   | CODE DESCRIPTION                                                                                         | STORA        |      | SURROUTINE USA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                             |  |
|--------|--------|----------------------------------------------------------------------------------------------------------|--------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|--|
| SYMBOL | SYMBOL | OF OCULTION                                                                                              | BLOCK        | LOC  | SUBR CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | DE VAR                                                      |  |
| ALFA   |        | 1 A 31 word array containing the mesh $x_0$ , $x_1$ , , $x_n$                                            | /BICUBE/(    | 204) | BLICO I<br>BLICO M<br>BLYNE I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                             |  |
| AMAX   | ×N     | The largest value of the first independent variabed of a bivariate table.                                | le /BICUBE/( | 2)   | BLYNE I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | AMAX                                                        |  |
| AMI N  | ×o     | I The smallest value of the first independent variable of a bivariate table.                             | /BICUBE/(    | 1)   | BLICO M<br>BLYNE I<br>INBVAD I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | AMIN                                                        |  |
| C      |        | O A 32 word array containing the spline coefficient for the two bivariate functions at rectangle IREC    |              | 12)  | BLYNE D<br>BLYNE I<br>INBVAD D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | C<br>CL00<br>E                                              |  |
| CLOO   | •      | 1 A 32 word array containing the spline coefficient<br>for the two bivariate functions at rectangle IREC |              | 12)  | BLYNE D<br>BLYNE I<br>INBVAD D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CF00<br>C                                                   |  |
| IF     |        | M Last file in the grid in which interpolation occurred.                                                 | /BI CUBE/(   | 3)   | BLYNE M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | IF                                                          |  |
| IFMAX  | N      | I Total number of files in grid.                                                                         | /BICUBE/(    | 4)   | BLICO M<br>BLYNE I<br>INBVAD I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | IRMAX<br>IFMAX                                              |  |
| IFOB   |        | I Forward or adjoint integration flag = 1 means forward = 2 means adjoint                                | /XCODES/(    | 178) | ACCEL I<br>BEROCO I<br>BLYNE I<br>EQUA3 I<br>IMPUL I<br>SPLYNE I<br>TOPM O                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | IFOB<br>IFOB<br>IFOB<br>IFOB<br>IFOB                        |  |
| IR     |        | M Last rank in the grid in which interpolation occurred.                                                 | /BICUBE/(    | 7)   | BLICO M<br>BLYNE M<br>INBVAD M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | IF<br>IR                                                    |  |
| IREC   |        | M Logical record on IUNIT that contains spline coefficients for rectangle IRECT.                         | /BICUBE/(    | 11)  | BLICO M<br>BLYNE M<br>INBVAD M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | IREC                                                        |  |
| IRECT  |        | M Grid rectangle associated with IR and IF.                                                              | /81CUBE/(    | 10)  | BLICO M<br>BLYNE M<br>INBVAD M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | IRECT                                                       |  |
| IRMAX  |        | I Total number of ranks in grid.                                                                         | /BICUBE/(    | 8 )  | BLICO M<br>BLYNE I<br>INBVAD I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | IFMAX<br>IRMAX                                              |  |
| 15TART |        | 0 Instralization and divergance flag                                                                     | /XCODES/(    | 147) | AST3 OBLGCON OBLYNE OF FING I MODELA OPROPIN OREUS I TEST MODELA OPPOPEN OF TOPM MODELA OPPOPEN OPPOPE | ISTAR<br>ISTAR<br>ISTAR<br>ISTAR<br>ISTAR<br>ISTAR<br>ISTAR |  |
| IUNIT  |        | I Logical unit number on which bicubic spline coefficients are stored for this table.                    | /BICUBE/(    | 9)   | BLICO M<br>BLYNE I<br>INBVAD I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | TINUT<br>TINUT                                              |  |
| MACH   |        | I A 31 word array containing the mesh $y_0, y_1, \dots, y_n$                                             | /BICUBE/(    | 235) | BLICO M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ALFA                                                        |  |
| MMAX   | Уm     | I The largest value of the second independent<br>variable of a bivariate table.                          | /8ICUBE/(    | 6 }  | BLICO D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | AMAX                                                        |  |
| MMI N  | Уo     | I The smallest value of the second independent<br>variable of a bivariate table.                         | /BICUBE/(    | 5 }  | BLICO O                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | AMIN                                                        |  |
| 7      |        | I A 160 word array containing logical record IREC.                                                       | /BICUBE/C    | 44)  | BLICO I<br>BLYNE I<br>INBVAD I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | T<br>T                                                      |  |

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```
SUBROUTINE BLYNE(a, A, U)
REAL M, K, MRIN, MMAX, MACH
COMMON/XCÓDES/ JKQ(177), IFOB
EQUIVALENCE(JKQ(141), ISTART)
COMMON /BICUBE/ AMIN, AMAX, IF, IFMAX, MMIN, MMAX, IB, IRMAX,
IJUNIT, IRECT, IREC, C(32), T(160), KNOTS(1)
DIMENSION U(6), ALFA(1), MACH(1)
EQUIVALENCE (ALFA, KNOTS), (MACH, KHOTS(32))
EQUIVALENCE (ALFA, KNOTS), (MACH, KHOTS(32))
EQUIVALENCE (1), (CL01, C(5)), (CL02, C(9)), (CL03, C(13)),
Z(CL10, C(2)), (CL11, C(6)), (CL12, C(10)), (CL13, C(141)),
3(CL20, C(3)), (CL21, C(7)), (CL22, C(11)), (CL23, C(15)),
4(CL30, C(4)), (CL31, C(8)), (CL32, C(12)), (CL33, C(16)),
5(CD00, C(17)), (CD01, C(21)), (CD02, C(25)), (CD03, C(29)),
6(CD10, C(18)), (CD11, C(22)), (CD12, C(26)), (CD13, C(30)),
7(CD20, C(17)), (CD21, C(23)), (CD22, C(27)), (CD23, C(31)),
8(CD30, C(20)), (CD31, C(24)), (CD32, C(28)), (CO33, C(32))
IF(MMIN LE M AND. M LE MMAX) GO TO 20
ISTART = 6
RETURN
RESULT REAL RESULT REAL RESULT 
   BLYNE
BLYNE
BLYNE
SEP18
BLYNE
   1.23456789012345678901
  BLYNE
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BLYNE
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BLYNE
BLYNE
BLYNE
BLYNE
BLYNE
  20-
   RETURN
10 CONTINUE
  SEP 18
BLYNE
  20 IF(AMIN LE A AND. A .LE. AMAX) 60 TO 30 IF(A .LT AMIN) A = AMIN IF(AMAX .LT. A) A = AMAX 30 IF(M - MACH(IR)) 40,80,50
   22.
23
24
  BLYNE
   BLYNE
   <del>40</del> 50
   25
   BLYNE
  26
27
   40 IR = IR ~ 1
60 TO 30
  SLYNE
   50 IF(N - MACH(IR + 1)) 80,60,70
60 IF(IR GE IRMAX) 60 TO 80
   28
   BLYNE
  29
   80-
   BLYNE
   30
31
   70 1R = 1R + 1
60 TO 30
   BLYNE
BLYNE
   80 IF(A - ALFA(IF)) 90,130,100
   70-7100-
   32.
  BLYNE
   1 1 3 O
   33
34
   90 1F = IF - 1
60 TO 80
   BLYNE
   80-
   BLYNE
  100 IF(A - ALFA(IF + 1)) 130,110,120
   110-120
  35
   BLYNE
   130
   130
   36.
  110 IF(IF GE IFMAX) 68 TO 130
   BLYNE
   37
38.
   120 IF = 1F + 1
GO TO 80
  BLYNE
   GO TO 80

130 H = A - ALFA(IF)
K = M - MACH(IR)
JRECT = IR + IRMAX*(IF - 1)
IF(JRECT EQ. IRECT) GO TO 160
IRECT = JRECT
JREC = (IRECT - 1)/5 + 2
IF(JREC = EQ. IREC) GO TO 140
IREC = JREC
CALL READMS(IUNIT, T, 160, IREC)
140 IB = 32*(IRECT - 5*IREC + 9)
DO 150 I = 1, 32
J = I + IB
150 C(I) = T(J)
160 CONTINUE
  BLYNE
BLYNE
BLYNE
BLYNE
BLYNE
BLYNE
   39.
40.
42.
43.
44.
45.
47.
  160-
  140-
   BLYNE
   48
49
50
51.
   BLYNE
   BLYNE
BLYNE
BLYNE
  5555555556623
  160 CONTINUE
  CONTINUE

CL0 = CL00 + K*(CL01 + K*(CL02 + K*CL03))

CL1 = CL10 + K*(CL11 + K*(CL12 + K*CL13))

CL2 = CL20 + K*(CL21 + K*(CL22 + K*CL23))

CL3 = CL30 + K*(CL31 + K*(CL22 + K*CL23))

U(1) = CL0 + H*(CL1 + H*(CL2 + H*CL3))

CD0 = CD00 + K*(CD01 + K*(CD02 + K*CD03))

CD1 = CD10 + K*(CD11 + K*(CD02 + K*CD03))

CD2 = CD20 + K*(CD11 + K*(CD22 + K*CD3))

CD3 = CD30 + K*(CD31 + K*(CD22 + K*CD23))

CD4 = CD50 + K*(CD31 + K*(CD22 + K*CD3))

U(4) = CD0 + H*(CD1 + H*(CD2 + H*C03))

GD T0 (180,170), FF08
  BIYNE
   BLYNE
BLYNE
BLYNE
BLYNE
BLYNE
BLYNE
BLYNE
BLYNE
BLYNE
PO14
  170-180-
  170 CLOPP = K*CLO3
CLOPP = CLOPP + CLOPP + CLOPP + CLO2
CLOP = CLO1 + K*(CLO2 + CLOPP)
CL1PP = K*CL13
CL1PP = CL1PP + CL1PP + CL1PP + CL12
   64.
65
66.
67
   BLYNE
BLYNE
BLYNE
BLYNE
  RIVNE
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```

311

```
CLIP = CL11 + K*(CL12 + CL1PP)
CL2PP = K*CL23
CL2PP = CL2PP + CL2PP + CL2PP + CL22
CL2P = CL2I + K*(CL22 + CL2PP)
CL3PP = K*CL33
CL3PP = CL3PP + CL3PP + CL3PP + CL32
CL3P = CL3I + K*(CL32 + CL3PP)
UXX = H*CL3
UXX = UXX + UXX + UXX + CL2
U(2) = CL1 + H*(CL2 + UXX)
U(3) = CL0P + H*(CL2 + UXX)
U(3) = CL0P + H*(CL1P + H*(CL2P + H*CL3P))
CD0PP = K*CD03
CD0PP = CD0PP + CD0PP + CD0PP + CD02
CD0P = CD01 + K*(CD12 + CD1PP)
CD1PP = K*CD13
C01PP = CD1PP + CD1PP + CD1PP + CD12
CD1PP = K*CD23
CD2PP = CD21 + K*(CD12 + CD1PP)
CD3PP = K*CD31
CD3PP = CD31 + K*(CD22 + CD2PP)
CD3PP = K0013
CD3PP = CD31 + K*(CD32 + CD3PP)
VXX = H*CD3
VXX = VXX + VXX + VXX + CD2
U(5) = CD1 + H*(CD1P + H*(CD2P + H*CD3P))
RETURN
UXX = H*CL3
IXX = H*CL3
IXX = H*XX + H*XX + H*X + F12
             BLYNE
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BLYNE
   180 UXX = H*CL3

UXX = UXX + UXX + UXX + CL2

U(2) = CL1 + H*(CL2 + UXX)

VXX = H*CD3

VXX = VXX + VXX + VXX + CD2

U(5) = CD1 + H*(CD2 + VXX)

190 RETURN

END
   BLYNE
BLYNE
BLYNE
PO14
PO14
PO14
BLYNE
BLYNE
97
98.
99
100
101.
102.
103.
```

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#### Subroutines BL2 Through BL9

#### Purpose

Subsoutine BL2 through BL9 supply (on option) the governing equation for the angle of attack,  $\alpha$ , element of the in-plane control vector. This is governing equation  $K_3$  described in Sections 9.2 and 10 of Volume I. The correspondence between subroutine and steering options is listed below:

| Subroutine Name | Steering Control Option                                    |
|-----------------|------------------------------------------------------------|
| BL2             | Constant angle of attack                                   |
| BL3             | Constant lift                                              |
| BL4             | Vertical rise of pitchover, $\mathring{\gamma}_{\neq}^* 0$ |
| BL5             | Unpowered total acceleration limit                         |
| BL6             | Gravity turn                                               |
| BL7             | Dynamic pressure limit                                     |
| BL8             | Heating rate limit                                         |
| BL9             | Reynolds number limit                                      |

Subroutines BL2 through BL9 are simplified versions of AL2 through AL9 used in the quasi-linearization module of PADS.

Each routine has a hierarchy of entry points. The entry points for example in BL7 include BL7010, BL7001 and BL 7000. The meaning of the numbers is similar in all of the "BL" routines and is spelled out below. (Subroutine BL7 is used only as an example).

Entry BL7000. Computes value of K3, the governing equation.

Entry BL7001. First computes partials of  $K_3$ , with respect to elements of the in-plane control vector and then computes  $K_3$ .

Entry BL7010. Computes explicit partials of  $K_3$  with respect to state, then computes partials of  $K_3$  with respect to the in-plane control vector and finally computes  $K_3$ .

# SUBRØUT I NE BL2

| FORTRAN<br>SYMBOL | MATH<br>Symbol | CODE | DESCRIPTION                                                                                                 |       | STA<br>BLOCA | )AAG       | E<br>LOC | SUBBOUTS<br>SUBBOUTS                                                                          | NE USAGE<br>DE VAR                            |
|-------------------|----------------|------|-------------------------------------------------------------------------------------------------------------|-------|--------------|------------|----------|-----------------------------------------------------------------------------------------------|-----------------------------------------------|
| ALPHA             | «              | 1    | Angle of attack                                                                                             | (RAD) | /AECO3       | 10         | 3)       | BEROCO I<br>BLGCON M<br>BL2 I<br>FNTG O<br>MAMECO I<br>MODELA M<br>MODELB O<br>REU3 O<br>VT I | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA              |
| CALPHA            |                | I    | Constant value of angle-of-attack                                                                           | (RAD) | /GENF        | 10         | 552)     | BL2 I<br>MODELA M<br>MODELB A                                                                 |                                               |
| XK3               |                | 0    | Third control vector governing equation value<br>Corresponds to error in algebraic equation<br>involving α. | •     | /GENF        | /(         | 574)     | BL2 0<br>BL3 0<br>BL4 0<br>BL5 0<br>BL6 0<br>BL6 0<br>BL8 0<br>MODELA F                       | XX3<br>XX3<br>XX3<br>XX3<br>XX3<br>XX3<br>XX3 |
| XK3A              |                | 0    | Partial of governing equation wrt state or covector component                                               | ntro} | /GENF        | <b>/</b> ( | 583)     | BLGCON I<br>BL2 0<br>BL3 0<br>BL4 0<br>BL5 M<br>BL6 0<br>BL7 0<br>BL8 0                       | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A          |

```
BL2
AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
                                 SUBROUTINE BL2
COMMON/AECO3/
*APHO APH
*SINA COS/
*COSPHI GOP!
ALPHA
PHIO
POPH
FK
CMAM CMM
CLA
CDM
  APHR
COSA
COSA
CLO
CHA
CLO
  ,VDA
,PHID
,XLAMA(9)
,XCGM
,CMO
,CLM
   ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
   ,PDA
,SINPHI
,CDG
,CLOM
,FKM
                                TOL(9),
COTI(9,9),
DPSQ,
PA,
CSR,
TOP,
DIS1(20),
TAX,
FPD,
LIFTY
DRAGY,
DB,
ULFTY,
XMCGA,
ZCC,
  NÉ/MOSP(20,2) YARQ(9)
ACON(9) BCON(9)
DT G
RE MACH
PAR ROR
TIMEPH TIMES
TPH (20) DIS(20)
TLS1 (20) DIP1(20)
LIFT DRAG
FP FPOLD
QV FVAC
LIFTA DBR
LIFTM DBR
  , SVAR(10), DCON(9), QCON(9), RO, VNR, TOS, TIME, TBURN, MACHR
   , WBC(20)
DTP
QS
, CS
, SUMSQ
, TR(9)
, OMP
, TBU(20)
, MACHY
  DRAGR
, 1SP
, ULFTR
, XMCGM
, DELTAE
, XJ
  DRAGA
ISPF
,ULFTA
,CODAE
,SID
                                  *LIFTR
   DBR
ULFT
XMCGR
CALPHA
XCG
                                , GAMMAD
  ,XKG
  , XKP
   , XK2
, XK2D
, XK2V
, XK2P
, XK2D
, XK2M
, PO
   , XK3
, XK3D
, XK3V
, XK3P
, XK3O
, XK3M
, DPDY(3,8)
  MÁCHÁ,
  MACH,
                C
                          ENTRY BL2001
46 XK3A = 1.
ENTRY BL2000
50 XK3 = ALPHA - CALPHA
                C
                                    RETURM
END
```

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## SUBRØUT INE BL3

| FORTRAN | MATH           | CODE | DESCRIPTION                                                                                                          |     |       | DARG |       | <u>5 บาคอบ</u>                                                 |                                           |                                                      |
|---------|----------------|------|----------------------------------------------------------------------------------------------------------------------|-----|-------|------|-------|----------------------------------------------------------------|-------------------------------------------|------------------------------------------------------|
| SYMBOL  | SYMBOL         | Cons | DESCRIPTION                                                                                                          |     | BLOCK |      | LOC   | 5 U B R                                                        | 0008                                      | VAR                                                  |
| CULFT   | •              | 1    | Constant value of ULFT (LBS                                                                                          | ) z | GENF  | 70   | 550)  | BL3<br>MODELA                                                  | I<br>O                                    | CULFT<br>CULFT                                       |
| ULFT    | L <sub>U</sub> | 1    | Untrimmed mero.lift                                                                                                  | /   | GENF  | ¥C   | 540)  | BL3<br>MODELA<br>VT                                            | I<br>I<br>M                               | ULFT<br>ULFT<br>ULFT                                 |
| ULFTA   |                | I    | Partial of ULFT wrt angle of attack                                                                                  | /   | GENF  | 70   | 543)  | BL3<br>VT                                                      | I<br>M                                    | ULFTA<br>ULFTA                                       |
| ULFTR   |                | I    | Partial of ULFT wrt altitude                                                                                         | /   | GENF  | /(   | 542)  | BL3<br>VT                                                      | I                                         | ULFTR<br>ULFTR                                       |
| ULFTV   |                | I    | Partial of ULFT wrt velocity                                                                                         | 1   | GENF  | 70   | 541)  | BL3<br>VT                                                      | I<br>M                                    | ULFTY<br>ULFTY                                       |
| XK3     |                |      | Third control vector governing equation value.<br>Corresponds to error in algebraic equation<br>involving $\alpha$ . | /   | GENF  | 70   | ·574) | BL2<br>BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8<br>MODELA<br>OUT | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>1<br>1 | XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3 |
| XK3A    |                |      | Partial of governing equation port state or control vector component                                                 | ′   | GENF  | 70   | 583)  | BLGCON<br>BLZ<br>BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8        | I 0 0 0 m 0 0 0                           | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A |
| XK3R    |                | 0    | Partial of governing equation wrt state or control vector component                                                  | ′   | GENF  | /(   | 595)  | BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8                         | 0 M 0 0 0                                 | XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R         |
| XK3V    |                | 0    | Partial of governing equation mrt state or control<br>vector component                                               | · / | GENF  | /(   | 586)  | 813<br>814<br>815<br>816<br>817<br>818                         | 0 0 0 0 0 0                               | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A                 |

```
SUBROUTINE BL3
COMMON/AECO3/
APHO APHR ALPHA
*SINA COSA PHIO
*COSPHI GDPH PDPH
*CDOM CLO FK
*CH CHA CHA CHA
*CL CLA
*CO CDA CDM
*COMMON/GENF/
*DMG(20) , OMGP(20,2) , VARQ(9)
*A(9,9) , ACON(9) *BCON(9)
*OTS DT SCON(9)
*TOTS DT SCON(9)
*TOTS DT SCON(9)
**TOTS DT SCO
  123 4567890112345678901234567890123345678901234567890123456789012345678901234567890123456789012345678901
  ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMGM
  ALPHA
PHIO
PBPH
FK
CHAM CMM
CLA
CDM
   ,VDA
,PHIB
,XLAMA(9)
,XCGM
,CMO
,CLM
   ,PDA
,SINPHI
,CDO
,CLGM
,FKM
   TOL(9)
COTI(9,9)
PA
PA
TOP
PA
TOP
DIS1(20)
TAX
TAX
TAX
PA
LIFTV
DRAGV
DB
ULFTV
XMCGA
COE
ZCC
  SYAR(10)
DCOH(9)
Q
RD
VNR
TDS
T
THE
TBURN
MACHR
  , WBC( 20 )
, OTP
, OS
, CS
, SUMSO
, TR( 9 )
, H
, ORP
, TBU( 20 )
, MACHY
   DRAGR
ISP
ULFTR
XMCSM
DELTAE
XJ
   DRAGA
ISPF
ULFTA
COBAE
SID
  DBR
ULFT
XACGR
CALPHA
XCG
  , GAMMAD
   , XKG
   , XKP
   2 , XK3
2D , XK3D
2Y , XK3D
2P , XK3D
2P , XK3D
2D , XK3D
2M , XK3M
MACH, MACHN,
   , XK2
, XK2D
, XK2V
, XK2P
, XK2D
, XK2A
, PD
  Ç
   RETURN
END
```

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## SUBRØUT I NE BL4

| FORTRAN<br>Symbol | MATH<br>Symbol               | CODE         | DESCRIPTION |        | STORAS<br>BLOCK | £<br>L∂C | SUBROUTING<br>SUBR CODE                                                                            | USAGE<br>VAR                                                                                     |
|-------------------|------------------------------|--------------|-------------|--------|-----------------|----------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| CODAE             | c ο s ( α - s <sub>E</sub> ) | I See symbol |             |        | /GENF /(        | 549)     |                                                                                                    | COBAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE                             |
| COSA              | cos∝                         | 1 See symbol |             |        | /AEC03 /(       | 8)       | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>FH3 I<br>OUT I                                      | COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA                                             |
| COSGAM            | cos(?)                       | I See symbol |             |        | /STATE3/(       | 687)     | ACCEL I BL4 I BL8 I DER3A I EQUA3 O MODELA I MODELB I OUT I POBC I PDY3A I                         | COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM |
| COSPHI            | cos∲                         | I See symbol |             |        | /AEC03 /(       | 13)      | ACCEL I BL4 I GUI3A M MODELA M MODELB M OUT I                                                      | COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI                                         |
| COSPS1            | cos( <b>∲</b> )              | ĭ See sy≋bol |             |        | /STATE3/(       | 705)     | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 I<br>MODELA I<br>MODELB I<br>POBC I<br>PDY3A I         | COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI                     |
| COSRHO            | c ο s(ρ)                     | I See symbol |             |        | /STATE3/(       | 707)     | 8L4 I<br>8L7 I<br>8L8 I<br>DER3A I<br>EQUAS M<br>MODELA I<br>MODELB I<br>OUT I<br>POBC I<br>POBC I | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO |
| COSZRØ            | cοs(2ρ)                      | I See symbol |             |        | /5TATE3/(       | 756)     | BL7 M                                                                                              | COS2RO<br>COS2RO<br>COS2RO<br>COS2RO<br>COS2RO                                                   |
| 08                | o <sub>b</sub>               | I Base drag  |             | ((B\$) | ∕GENF /(        | 537)     | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>EQUA3 I<br>FH3 I<br>OUT I<br>SDER3 I<br>VT I        | 08<br>08<br>08<br>08<br>08<br>08<br>08                                                           |

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| OHIKAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                         |             | STI<br>BLOCK | ORAG<br>( | LOC  | <u> </u>                                                              |                            |                                                              |
|------------------|----------------|------|-------------------------------------|-------------|--------------|-----------|------|-----------------------------------------------------------------------|----------------------------|--------------------------------------------------------------|
| DBR              |                | 1 (  | Partial of base drag mrt altitude   | 1           | /GENF        | /(        | 536) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EOUA3                            | I<br>I<br>I<br>I           | DBR<br>DBR<br>DBR<br>OBR<br>DBR                              |
| G                | g              | 1 (  | Gravitational attraction            | (FT/SEC**2) | /GENF        | /(        | 301) | FH3<br>VT                                                             | I<br>I<br>I<br>I<br>I      | 008<br>008<br>000<br>000<br>000<br>000<br>000                |
| GAMMAD           |                | I f  | Pitch rate                          | (RAD)       | /GENF        | /(        | 564) | BL4<br>PROPB<br>PROPIN                                                | I<br>0<br>0                | BAMMAB<br>AMMAB<br>AMMAB                                     |
| LIFT             | L              | 1 4  | Aerodynamic lift                    | (LBS)       | /GENF        | /(        | 496) | ACCEL<br>BL5<br>BL5<br>BL6<br>ENVPRM<br>FH3<br>OUT<br>PROPB<br>PROPIN | I<br>I<br>I<br>I<br>I<br>I | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT |
| .IFTA            |                | I F  | Partial of lift wrt angle-of-attack |             | /GENF        | 70        | 531) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                               | I<br>I<br>I<br>I<br>O      | LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA                    |
| .IFTM            |                | I F  | Partial of LIFT wrt wass            |             | /GENF        | /(        | 535) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                               | I<br>I<br>I<br>I<br>O      | LIFTE<br>LIFTE<br>LIFTE<br>LIFTE<br>LIFTE                    |
| .IFTR            | ٠              | I F  | Partial of lift prt altitude        |             | /GENF        | /(        | 530) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                               | I<br>I<br>I<br>I<br>I      | LIFTI<br>LIFTI<br>LIFTI<br>LIFTI<br>LIFTI                    |
| .1FTV            |                | 1 F  | Partial of lift wrt velocity        |             | /GENF        | /(        | 529) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                               | I<br>I<br>I<br>I<br>I      | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT                         |
| 1                | a              | I f  | 9ass                                |             | /STATE:      | 3/(       | 4)   | ACCEL<br>BL4<br>BL8<br>EQUA3<br>OUT<br>SDER3                          | I<br>I<br>I<br>I<br>I      | M<br>M<br>M<br>M                                             |
| ) ME GA          | ω              | 1 6  | Earth rotation rate                 | (RAD/SEC)   | /STATE:      | 3/(       | 7191 | BL4<br>BL7<br>Topm                                                    | I<br>O                     | OMEGA<br>OMEGA                                               |
| ) ME GA2         | ω <sup>2</sup> | I S  | See symbol                          |             | /STATE:      | 3/(       | 720) | BL4<br>BL7<br>BL8<br>TOPM                                             | I<br>I<br>I<br>0           | OMEGA<br>OMEGA<br>OMEGA                                      |

| FORTRAN<br>Symbol | MATH<br>Symbol            | CODE | DESCRIPTION                                    |         | BLOCK    | AGF<br>LOC | SUBRO<br>SUBR                                                                 | CODE                  | USAG<br>VAR                                                                                 |
|-------------------|---------------------------|------|------------------------------------------------|---------|----------|------------|-------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------------|
|                   |                           |      |                                                |         | . Agus   |            | ***                                                                           |                       |                                                                                             |
| PG                |                           | M.   | Partial of # wrt state                         |         |          | ( 606)     |                                                                               | Pi<br>M               |                                                                                             |
| P0                |                           | m    | Partial of # mrt state                         |         |          | ( 609)     |                                                                               | Ld                    | PÛ                                                                                          |
| PP                |                           | M,   | Partial of # wrt state                         |         |          | ( 607)     |                                                                               | rs<br>~               |                                                                                             |
| PR<br>PV          |                           | W.   | Partial of # mrt state                         |         |          | ( 608)     |                                                                               | ři<br>ři              | PR<br>PV                                                                                    |
|                   | _                         | M    | Partial of # mrt state                         | ( C T ) |          | ( 605)     |                                                                               |                       |                                                                                             |
| Ħ                 | R                         | Ī    | Radial distance from earth center to vehicle - | (+1)    | /GENF /  | ( 305)     | BL7<br>BL8<br>DER3A<br>EQUA3<br>MODEL<br>MODEL<br>PDBC<br>PDY3A<br>TRTOS:     | I B<br>I<br>I         | R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R |
| SIDAE             | 5 ; n (α-δ <sub>Ε</sub> ) | I    | See symbol                                     |         | /GENF /  | ( 557)     | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>VT                                | I<br>I<br>I<br>I<br>I | SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE                                          |
| SINA              | SÌn∝                      | I    | See symbol ,                                   |         | /AEC03 / | '( 7)      | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>GUI3A<br>OUT<br>VT                | I<br>I<br>I<br>I<br>M | SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA                                |
| SINGAM            | sin( > )                  | t    | See symbol                                     |         | /STATE3, | '( 688)    | BL4<br>BL8<br>DER3A<br>EQUA3<br>MODEL<br>MODEL<br>PDBC<br>PDY3A<br>SDER3      | O<br>A I              | SING<br>SING<br>SING<br>SING<br>SING<br>SING<br>SING                                        |
| SINPHI            | sin∲                      | I    | See symbol                                     |         | /AECO3 / | '( 12)     | ACCEL<br>BL4<br>MODEL<br>MODEL<br>OUT                                         | I<br>A M              | SINP<br>SINP<br>SINP<br>SINP<br>SINP                                                        |
| SINPSI            | șin(∳)                    | 1    | See symbol                                     |         | /STATE3  | · ( 704)   | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODEL<br>MODEL<br>PDBC<br>PDY3A        | 0<br>A I<br>B I<br>I  | SINP<br>SINP<br>SINP<br>SINP<br>SINP<br>SINP<br>SINP<br>SINP                                |
| 5 I NR HQ         | <b>\$ ι π( ρ )</b>        | I    | See symbol                                     |         | /STATE3  | '( 706)    | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODEL<br>MODEL<br>OUT<br>POBC<br>PDY3A | O<br>A I<br>B I<br>I  | SINR<br>SINR<br>SINR<br>SINR<br>SINR<br>SINR<br>SINR<br>SINR                                |

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| FORTRAN<br>Symbol | MATH<br>Symbol       | COD | DESCRIPTION                                                                                                         | STORA<br>Block | GE<br>LOC | SUBROUTINE USAGE<br>SUBA CODE VAR                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|----------------------|-----|---------------------------------------------------------------------------------------------------------------------|----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SINZRO            | sin(2 <sub>p</sub> ) | i   | See symbol                                                                                                          | /STATE3/(      | 755)      | 8L4 I SIN2RO<br>8L7 M SIN2RO<br>8L8 M SIN2RO<br>MODELA O SIN2RO<br>MODELB O SIN2RO                                                                                                                                                                                                                                                                                                             |
| T                 | T                    | ī   | Thrust                                                                                                              | ) /GENF /(     | 411)      | ACCEL I T BLGCON M T BL4 I T BL6 I T BL7 I T BL8 I T EL2 I T EQUAS O T FH1 I T FH2 I T FH4 I T FH4 I T FM4 I T FM9UL I T PROPB O T PROPIN O T REUS O T SDERS I T                                                                                                                                                                                                                               |
| ٧                 | •                    | Ī   | Relative velocity {FT/SEC                                                                                           | ) /STATE3/(    | 1)        | ACCEL I V ADICBS O VAR ADJUST M VAR ADJUST M VAR AGETBS O VAR ASTS I VAR BL4 I V BL7 I V BL8 I V CONS I VAR DERSA I VAR OUT I VAR OUT I VAR OUT I VAR POBC I V PDUSA M VAR RKTASA M VAR RKTASA M VAR RKTASA M VAR RKTASA M VAR TOPM I VAR |
| XKG               | k,                   | I   | Algebraic equation used in vertical rise and pitchover                                                              | /GEÑF /(       | 565)      | BL4 I XKG<br>MODELA M XKGAM<br>MODELB M XKGAM                                                                                                                                                                                                                                                                                                                                                  |
| XKP               | k <sub>.v</sub>      | I   | Algebraic equation used in vertical rise and pitchover                                                              | /GENF /(       | 566)      | BL4 I XXP MODELA M XKPS MODELA I XKPSI MODELB M XXPS MODELB I XKPSI                                                                                                                                                                                                                                                                                                                            |
| ХКЗ               |                      | 0   | Third control vector governing equation value<br>Corresponds to error in algebraic equation<br>involving $\alpha$ . | /GENF /(       | 574)      | BL2 0 XK3 BL3 0 XK3 BL4 0 XK3 BL5 0 XK3 BL6 0 XK3 BL7 0 XK3 BL8 0 XK3 MDDELA 1 XK3 OUT 1 XK3                                                                                                                                                                                                                                                                                                   |

| ORTHAN | HTAM   | Cope | DESCRIPTION                                                         | 5.1   | DRAG | E    | SUBROU                                                  | TINE        | USAGE                                                |
|--------|--------|------|---------------------------------------------------------------------|-------|------|------|---------------------------------------------------------|-------------|------------------------------------------------------|
| TABBOT | SYMBOL | TOUE | DESCRIPTION                                                         | წლენი | K    | LOC  | SUBK                                                    | CODE        | PAR                                                  |
| XK3A   |        | 0    | Partial of governing equation mrt state or control vector component | /GENF | /(   | 583) | BLGCON<br>BL2<br>BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8 | 0000000     | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A |
| XK3D   |        | 0    | Partial of governing equation wrt state or control vector component | /GENF | /(   | 580) | BLGCON<br>BL4<br>BL6<br>BL7<br>BL8                      | 0           | XK3D<br>XK3D<br>XK3D<br>XK3D<br>XK3D                 |
| XK3G   |        | 0    | Partial of governing equation wrt state or control vector component | /GENF | /(   | 589) | 814<br>817<br>818                                       | Đ           | XK36<br>XK36<br>XK36                                 |
| XK3M   |        | 0    | Partial of governing equation ørt state or control vector component | /GENF | /(   | 604) | BL4<br>BL5<br>BL6<br>BL7<br>BL8                         | M<br>D<br>O | XK3M<br>XK3M<br>XK3M<br>XK3M                         |
| XK30   |        | 0    | Partial of governing equation ært state or control vector component | /GENF | 70   | 598) | BL4<br>BL7<br>BL8                                       | Ð           | XK30<br>XK30<br>XK30                                 |
| XK3P   |        | 0    | Partial of governing equation mrt state or control vector component | /GENF | /(   | 592) | BL4<br>BL7<br>BL8                                       | Ū           | XK3P<br>XK3P<br>XK3P                                 |
| XK3R   |        | 0    | Partial of governing equation wrt state or control vector component | /GENF | /(   | 595) | BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8                  | 0<br>M<br>0 | XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R         |
| XK3T   |        | Ð    | Partial of governing equation art state or control vector component | /GENF | 73   | 577) | BLGCON<br>BL4<br>BL6<br>BL7<br>BL8                      | 0           | XK3T<br>XK3T<br>XK3T<br>XK3T<br>XK3T                 |
| XK3V   |        | O    | Partial of governing equation art state or control vector component | /GENF | /(   | 586) | BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8                  | 0<br>0<br>0 | XK3V<br>XK3V<br>XK3V<br>XK3V                         |

```
SUBROUTINE BL4
 1.
23.
45.
78
10.
112.
115.
115.
17.
  APHR
COSA
GDPH
CLO
CMA
  ,PDA
,SINPHI
,CDG
,CLGM
,FKM
  ,ALPHA
,PHIO
,PDPH
,FK
,CMAM ,CMM
  , YDA
, PHID
, XLAMA(9)
, XCGM
, CMO
   ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
  *APHO
*SINA
*COSPHI
  MDC(20)
OTP
QS
CS
SUMSQ
TR(9)
H
OMP
TBU(20)
  SVAR(10)
DCGN(9)
RG
VNR
TOS
T
TIME
TBURN
MACHR
  ,TOL(9)
,COTI(9,9)
,DP50
,PA
,CSR
,TOP
   SENF
SENF
SENF
SENF
SENF
SENF
SENF
SENF
  ,TBP
,DIP(20)
,DIS1(20)
,TAX
,FPD
,LIFTV
DRAGV
BRAGR
15P
,ULFTR
,MCGM
,DELTAE
,XJ
  ORAGA
ISPF
ULFTA
CODAE
SIB
  GENF
GENF
GENF
  , DBR
ULFT
XMCGR
CALPHA
XCS
  , DB
, ULFTV
, XMCGA
, CDE
, ZCG
   SENF
SENF
SENF
SENF
  , XKP
   , GAMMAD
  , XKG
  GENF
   SENF
SENF
SENF
SENF
SENF
SENF
  , XK1
, XK1D
, XK1V
, XK1P
, XK1B
, XK1M
, PR
   XK2D
XK2D
XK2V
XK2P
XK2D
XK2M
PO
  , XK3
, XK3D
, XK3V
, XK3P
, XK30
, XK3M
, DPDY(3,8)
   GEMF
GEMF
GEMF
FRAT
GEMF
SENF
STATE30
   HÁCHR
   MACH,
   * ISP, ISPF, MACHYLIFTY IRATED
DIRENSION TPHI(10),TST3(10)
EQUIVALENCE(TLP1,TPHI),(TLS1,TST1)
COMMON/STATE3/
*VARC1+) , DVAR (14),VARL (99) , DVARL(99) , VO(9)
*XL(9,9) , YOP(20,9),YOS (20,9),COSGAM , SINGAM , SAVBP(15),
*SINPSI , COSPSI , SINAHO , COSRHO , OCORHO , OCORDO ,
*SVBV (9), OMEGA , OMEGA2 , OMEGA
   STATES
  STATE3D
STATE3D
EQUV3
EQUV3
  E00A3
E00A3
E00A3
   ASF(X, Y) = (XKG+Y - XKP+X)/SDUARE
ENTRY BL4010
ASSIGN 5 TO LGD
ASSIGN 5 TO LGBL
GO TO 4
ENTRY BL4001
ASSIGN 40 TO IGD
GD TO 5
ENTRY BL4000
GD TO 5
ENTRY BL4000
GO TO 5
                                     C
  BL4
BL4
BL4
BL4
BL4
BL4
BL4
BL4
BL4
BL4
   BL4
   4 SQUARE = XKS++2 + XKP++2
SQSQ = SQUARE++2
YYR = LIFTR - DBR+5INA
  73
74.
75
   BL4
BL4
BL4
```

20 OCT 72 S 01-46

# SUBRØUTINE BL5

| FORTRAN<br>Symbol | MATH<br>Symbol   | CODE | DESCRIPTION                              |                                      | BLOIK   | RAG | LOC  | SUBROUTIN<br>SUBR COD                                                                                                                                                                                                                                                                                                                                                                     | E USAGE<br>E VAR                                                     |
|-------------------|------------------|------|------------------------------------------|--------------------------------------|---------|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
|                   |                  | *    |                                          |                                      |         |     |      |                                                                                                                                                                                                                                                                                                                                                                                           |                                                                      |
| DRAG              | D                | i    | Aerodynamic drag                         | (LBS)                                | /GENF   | 71  | 497) | ACCEL I<br>BL5 I<br>BL7 I<br>BL8 I<br>ENVPRM I<br>FN3 I<br>OUT I<br>PROPB O<br>PROPIN O<br>PROPIN O<br>SOER3 I<br>VT M                                                                                                                                                                                                                                                                    | DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG         |
| DRAGA             |                  |      | Partial of drag wrt angle of attack      | •                                    | ≠GENF   | /(  | 534) | ACCEL I<br>8L5 I<br>8L7 I<br>8L8 I<br>FH3 I<br>VT M                                                                                                                                                                                                                                                                                                                                       | DRAGA<br>DRAGA<br>DRAGA<br>DRAGA<br>DRAGA<br>DRAGA                   |
| DRAGR             |                  | I    | Partial drag mrt altitude                |                                      | / GENF  | /(  | 533) | ACCEL I<br>BL5 I<br>BL7 I<br>BL8 I<br>FH3 I<br>VT M                                                                                                                                                                                                                                                                                                                                       | DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR                   |
| DRAGV             |                  | I    | Partial of drag mrt velocity             |                                      | /GENF   | /(  | 532) | ACCEL I<br>BL5 I<br>BL7 I<br>BL8 I<br>FH3 I<br>VT M                                                                                                                                                                                                                                                                                                                                       | DRAGV<br>DRAGV<br>DRAGV<br>DRAGV<br>DRAGV<br>DRAGV                   |
| GMAX              | G <sub>max</sub> | I    | Maximum total acceleration g load        |                                      | /ARCDA? | 1/( | 12)  | BL5 I<br>FH3 I<br>MODELA I<br>PROPB I<br>PROPIN I                                                                                                                                                                                                                                                                                                                                         | GMAX<br>GMAX<br>GMAX<br>GMAX<br>GMAX                                 |
| GR                | g r              | 1    | Gravitational acceleration at surface of | the earth.<br>(FT/SEC <sup>2</sup> ) | /GLDBAL | -/\ | 1)   | ACCEL I BL5 I I EQUA 3 I FH3 I FH3 I GEINP I GEINP I GEINP I POBC I I POBC I I SOINP I SIZE I SIZZ I I I I | GR<br>GR<br>GR<br>GR<br>GR<br>GR<br>GR<br>GR<br>GR<br>GR<br>GR<br>GR |
| LIFT              | L                | I    | Aerodynamic lift                         | (LBS)                                | /GENF   | /(  | 496) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>ENVPRM I<br>FH3 I<br>OUT I<br>PROPB O<br>PROPIN O                                                                                                                                                                                                                                                                                                   | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT         |
| LIFTA             |                  | 1    | Partial of lift #rt angle-of-attack      |                                      | /GENF   | 10  | 531) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT 0                                                                                                                                                                                                                                                                                                                                       | LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA          |

| FORTRAN<br>SYMBOL | MATH<br>Symbol | CODE DE                                   | SCRIPTION                                              | S TORA<br>BLOCK | 3E<br>L0C | SUBROUTIN<br>SUBR CO                                                           |                                                      |
|-------------------|----------------|-------------------------------------------|--------------------------------------------------------|-----------------|-----------|--------------------------------------------------------------------------------|------------------------------------------------------|
| L1FTM             |                | I Partial of LIFT wrt                     | Mess                                                   | /GENF /(        | 535)      | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT 0                            | LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM   |
| LIFTR             |                | I Partial of lift wrt                     | altitude                                               | /GENF /(        | 530)      | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT 0                            | LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR   |
| LIFTY             |                | I Partial of lift ort                     | velocity                                               | /GENF /(        | 529)      | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VI O                            | LIFTY<br>LIFTY<br>LIFTY<br>LIFTY<br>LIFTY            |
| u                 | W              | I Weight                                  | (LBS)                                                  | /GENF /{        | 412)      | BL5 I<br>ENVPRM I<br>EQUAS M<br>FH3 I<br>OUT I<br>POBC I<br>REUS I<br>TRTOSZ I | 교<br>교<br>의<br>의                                     |
| XK3               |                |                                           | r governing equation value.<br>r in algebraic equation | /GENF /(        | 574)      | BL2 0<br>BL3 0<br>BL4 0<br>BL5 0<br>BL6 0<br>BL7 0<br>BL8 0<br>MODELA I        | XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3        |
| XK3A              |                | M Partial of governin<br>vector component | g equation wrt state or control                        | /GENF /(        | 583)      | BLGCON I<br>BL2 0<br>BL3 0<br>BL4 0<br>BL5 M<br>BL6 0<br>BL7 0<br>BL8 0        | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A |
| XK3M              |                | M Partial of governin<br>vector component | g equation wrt state or control                        | /GENF /(        | 604)      | BL4 0<br>BL5 M<br>BL6 0<br>BL7 0<br>BL8 0                                      | XK3M<br>,XK3M<br>XK3M<br>XK3M<br>XK3M                |
| XK3R              |                | M Partial of governin<br>vector component | g equation ørt state or control                        | /GENF /(        | 595)      | BL3 0<br>BL4 0<br>BL5 M<br>BL6 0<br>BL7 0<br>BL8 0                             | XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R         |
| XK3A              |                | M Partial of governin<br>vector component | g equation ært state or control                        | /GENF /         | 586)      | BL3 0<br>BL4 0<br>BL5 M<br>BL6 0<br>BL7 0<br>BL8 0                             | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A                 |

```
BL5
BL5
GLOBAL
GLOBAL
GLOBAL
GLOBAL
      1.23.4567
   SUBROUTINE BLS
                                     C
   COMMON/GLOBAL/
  , YMURF
, NF ARC
   ,LUM
,ID(4)
  IPFLG2,IPFLG3,IPFLG4,INEQFL(20)
  GLOBAL
RETURAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
DTNC
  DTPI
  OMAX
PHMAX
MAEF
MUDA
   SMAX
MAEA
MAEG
MUDB
XT
  . RĒMAX
  , VOA
, PHID
, XLAMA(9)
, XEGM
, CMO
, CLM
  ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
   PDA
SINPHI
CDO
CLOM
FKM
   NF/

,0mGP(20,2),VARQ(9),

ACGN(9), G

RE, MACH,

PAR, ROR,

,THEPH, TIMES,

,TPH (20),01P1(20),

,TLS1 (20),01P1(20),

LIFT, PPOLD,

QV, FYAC,

LIFTA, DBR,

LIFTA, ULFT
   COMMON/64
#0M6(20)
#A(9,9)
#DTS
#R
#YNU
#5VSQ
#TST(20)
#TIAPIC20)
#TIMPR
#AE
  ,TOL(9)
,COTI(9,9)
,DPSQ
,PA
,TOP
,DIP(20)
,DIS1(20)
,TAX
,FPD
,LIFTY
,DRAGY
,DB
   , WDC( 20 )
DTP
QS
, CS
, SUMSQ
, TR( 9 )
H
, DMP
, TBU( 20 )
, MACHY
  GENF
   GENF
GENF
GENF
GENF
GENF
GENF
  SVAR(10)
   RO
VNR
TOS
   TIME
TBURN
MACHR
   SEENANT FEBRUARY OF GEOGRAPH AND SEEN OF GEOGRAPH A
   DRAGA
ISPF
ULFTA
CODAE
   , DRAGR
  *LIFTR
  DBR
ULFT
XMCGR
CALPHA
XCG
   DHAGV
DB
ULFTV
XMCGA
CDE
,ZCG
  , DELTAE
, XJ
  ,SID
  , GAMMAD
   , XKG
   , XKP
   XK1
,XK1B
,XK1V
,XK1P
,XK1O
,XK1B
,PB
  , XK2
, XK2D
, XK2V
, XK2P
, XK2P
, XK2FI
  *FRAT(
*P1
*XK1T
*XK1A
*XK16
*XK1R
*XK1U
*PV
  XK3
XK3D
XK3V
XK3P
XK3D
XK3D
  GENF
GENF
GENF
FRAT
GENF
GENF
  'PN
   MACH, MÁCHR,
  40
                                       C
  RETURN
END
```

## SUBRØUTINE BL6

| FORTRAN | MATH                   | CODE DESCRIPTION                            |       | STORA     |      | SUBROUTIN                                                                                   |                                                                      |
|---------|------------------------|---------------------------------------------|-------|-----------|------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| SYMBOL  | SYMBOL                 | OESCHIFTION                                 |       | BLOCK     | LOC  | 508m (20                                                                                    | E VAR                                                                |
| CODAE   | cοs(α-ε <sub>Ε</sub> ) | 1 See symbol                                |       | /GENF /(  | 549) | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>FH3 I<br>SDER3 I<br>VT O                     | CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE |
| COSA    | Cos∝                   | I See symbol                                |       | /AEC03 /( | 8)   | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>FH3 I<br>OUT I<br>VT M                       | COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA                 |
| DB      | D <sub>b</sub>         | I Base dr <b>a</b> g                        | (LBS) | /GENÉ /(  | 537) | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>EQUAS I<br>FH3 I<br>OUT I<br>SDERS I<br>VT I | DB<br>DB<br>DB<br>DB<br>DB<br>DB<br>DB                               |
| DBR     |                        | I Partial of base drag <b>wrt altitud</b> e |       | /GENF /(  | 536) | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>EQUAS I<br>FH3 I<br>VT I                     | DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR                        |
| LIFŤ    | L                      | I Aerodynamic lift                          | (LBS) | /GENF /(  | 496) | ACCEL I BL4 1 BL5 I BL6 I ENVPRM I FH3 I OUT I PROPB O PROPIN O                             | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT         |
| LIFTA   |                        | I Partial of lift wrt angle-of-attack       |       | /GENF /(  | 531) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT Q                                         | LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA                   |
| LIFTM   |                        | I Par-tial of LIFT wrt wass                 |       | /GENF /(  | 535) |                                                                                             | LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM                   |
| LIFTR   |                        | I Partial of lift wrt altitude              |       | /GENF /(  | 530) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT 0                                         | LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR                   |
| LIFTV   |                        | I Partial of lift mrt velocity              |       | /GENF /(  | 529) | ACCEL I<br>BL4 I<br>BL5 I<br>BL6 I<br>FH3 I<br>VT O                                         | LIFTV<br>LIFTV<br>LIFTV<br>LIFTV<br>LIFTV                            |

| FORTRAN<br>Symbol | MATH<br>Symbol         | COO | DESCRIPTION                                                                                                    | BLOCK  | ORAC | ξ<br>LOL | <u> </u>                                                       | T I NE                                                                                      | US AGE<br>VAR                                                |
|-------------------|------------------------|-----|----------------------------------------------------------------------------------------------------------------|--------|------|----------|----------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| 37.1002           | 3111000                |     |                                                                                                                | 0000   |      |          | 33011                                                          |                                                                                             | . ,,,,,                                                      |
| SIDAE             | sin(α-ε <sub>Ε</sub> ) | I   | See symbol                                                                                                     | /GENF  | /(   | 557)     | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>VT                 | 1<br>1<br>1<br>1<br>1                                                                       | SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE  |
| SINA              | \$1n∝                  | ī   | See symbol                                                                                                     | /AEC03 | /C   | 7)       | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>GUI3A<br>OUT<br>VT | I<br>I<br>I<br>I<br>M<br>I                                                                  | SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA |
| Ţ                 | T                      | I   | Thrust (LBS)                                                                                                   | / GENF | /(   | 411)     | ACCELON BL4 BL4 BL7 BL8 ELQUA FH12 FH3 FH4 IMPTOPN PROUN RDER3 | I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I | T                                                            |
| хкз               |                        | 0   | Third control vector governing equation value. Corresponds to error in algebraic equation involving $\alpha$ . | /GENF  | /(   | 574)     | BL2<br>BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8<br>MODELA<br>OUT | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>1<br>1                                                   | XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3         |
| XK3A              |                        | 0   | Partial of governing equation wrt state or control vector component                                            | / GENF | 70   | 583)     | BLGCON<br>BL2<br>BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8        | 1<br>0<br>0<br>0<br>m<br>0                                                                  | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A         |
| XK3D              |                        | 0   | Partial of governing equation wrt state or control vector component                                            | / GENF | /(   | 580)     | BLGCON<br>BL4<br>BL6<br>BL7<br>BL8                             | 0                                                                                           | XK3D<br>XK3D<br>XK3D<br>XK3D                                 |
| XK3M              |                        | 0   | Partial of governing equation wrt state or control vector component                                            | / GENF | /(   | 604)     |                                                                | 0<br>0<br>0<br>0                                                                            | XK3M<br>XK3M<br>XK3M<br>XK3M<br>XK3M                         |
| XK3R              |                        | 0   | Partial of governing equation wrt state or control vector component                                            | /GENF  | /(   | 595)     |                                                                | 0<br>M<br>0<br>0                                                                            | XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R                 |

| FORTRAN<br>SYMBOL | MATH<br>SYMBOL | CODE | DESCRIPTION                                                         | 51;<br>9100K | DRAGE<br>LOC |                                        | TINE USAG<br>COOE VAR                          |
|-------------------|----------------|------|---------------------------------------------------------------------|--------------|--------------|----------------------------------------|------------------------------------------------|
| хкэт              |                |      | Partimi of governing equation wrt state or control vector component | /GENF        | /( 577)      | BLGCON<br>BL4<br>BL6<br>BL7<br>BLB     | I XK3T<br>D XK3T<br>D XK3T<br>D XK3T<br>D XK3T |
| XK3V              |                |      | Partial of governing equation wrt state or control vector component | /GENF        | /( 586)      | BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8 | 0 XK3V<br>0 XK3V<br>0 XK3V<br>0 XK3V<br>0 XK3V |

```
6 ARREST SECURIOR SEC
TOL(9)
COTI(9,9)
PA
CSR
TOP
OISY(20)
DISY(20)
TAX
FPD
URAGV
DRAGV
OB
ULFTV
XMCGA
, ZCG
   SVAR(10)
DCON(9)
Q
RD
RD
VNR
TOS
T
TIME
TBURN
MACHR
   MDC(20)
DTP
QS
CS
SUMSQ
TR(9)
H
OMP
TBU(20)
MACHY
   DRAGR
ISP
ULFTR
XMCGM
DELTAE
  DRAGA
ISPF
ULFTA
CODAE
SID
  DBR
ULFT
XMCGR
CALPHA
XCG
   , GAMMAD
   , XKG
  , XKP
   XK2
XK20
XK2V
XK2P
XK20
XK2N
PO
   , XK1
, XK10
, XK1V
, XK1P
, XK10
, XK1M
, PR
   , XK3
, XK30
, XK3P
, XK30
, XK3N
  MACH, MÁCHR,
   A , VDA
, PHID
, XLAMA(9)
, XCSM
, CMM , CMG
, CLM
   ,GDA
PHI
,XLAMP(9)
,ZCGM
,CMOM
   PDA
SINPHI
CDO
CLOM
FKM
   ASSIGN 50 TO 160

5 TCDAE = T*CODAE
TSDAE = T*SIDAE
UBCA = DB*COSA
DBSA = DB*SINA
60 TO 160
20 XK3V = LIFTY
XK3R = LIFTR - DBR*SINA
XK3M = LIFTR
40 XK3T = SIDAE
XK3A = TCDAE
XK3A = TCDAE + LIFTA
50 XK3 = TSDAE + LIFT + DBSA
555555555556623.
   20
   40
   50
  C
  RETURN
END
```

20 801 72 6.01-46

334

## SUBRØUT I NE BL7

| FORTRAN | MATH                         | CODE           | DESCRIPTION           |             | STORA      | SE   | SUAROU                                                                        | TIME USAG                                                                            |
|---------|------------------------------|----------------|-----------------------|-------------|------------|------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL                       |                | DEOGRAFI LION         | <del></del> | BLOCK      | LOC  | รับชล (                                                                       | CODE VAR                                                                             |
| CODAE   | c ο s ( α - δ <sub>Ε</sub> ) | 1 See sy≡bol   |                       |             | /GENF /(   | 549) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>SDER3<br>VT                       | 1 CODAE<br>1 CODAE<br>1 CODAE<br>1 CODAE<br>1 CODAE<br>1 CODAE<br>1 CODAE<br>0 CODAE |
| COSA    | C O S ∝                      | I Sae sy≋bol   |                       |             | /AEC03 /(  | 8)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>OUT<br>VT                         | I COSA<br>I COSA<br>I COSA<br>I COSA<br>I COSA<br>I COSA<br>I COSA<br>M COSA         |
| COSPSI  | cos( <b>∀</b> )              | I See symbol   |                       |             | /STATE3/(  | 705) | BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA                                        | I COSPS      |
| COSRHO  | cοs(ρ)                       | i See symbol   |                       |             | /STATE3/(  | 707) | BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>OUT<br>PDBC               |                                                                                      |
| COS2RO  | c σ s ( 2ρ )                 | M See symbol   |                       |             | /\$TATE3/( | 756) | BL4<br>BL7<br>BL8<br>MODELA                                                   | I COS2R<br>M COS2R<br>M COS2R                                                        |
| DB      | D <sub>b</sub>               | l Base drag    |                       | (LBS)       | /GENF /(   | 537) | ACCEL<br>BL6<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>OUT<br>SDER3<br>VT       | I 08<br>I 08<br>I 08<br>I 08<br>I 08<br>I 08<br>I 08<br>I 08                         |
| DBA     |                              | I Partial of b | ase drag wrt altitude |             | /GENF /(   | 536) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>VT                       | I DBR<br>I DBR<br>I DBR<br>I CBR<br>I CBR<br>I DBR<br>I DBR<br>I DBR                 |
| DRAG    | D                            | I Aerodynamic  | drag                  | (L85)       | /GENF /(   | 497) | ACCEL<br>BL7<br>BL8<br>ENVPRM<br>FH3<br>OUT<br>PROPB<br>PROPIN<br>SDER3<br>VT | I DRAG O DRAG                       |

| FORTRAN<br>Symbol | MATH<br>Symbol         | CODE | DESCRIPTION                                |            | ST<br>BLOCK | ORAL<br>K | LOC   | <u> </u>                                                                            |                       |                                                             |
|-------------------|------------------------|------|--------------------------------------------|------------|-------------|-----------|-------|-------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------|
| DRAGA             |                        | 1    | Partial of drag art angle of attack        |            | /GENF       | /(        | 534)  | ACCEL<br>BL5<br>BL7<br>BL8<br>FH3                                                   | I<br>I<br>I           | DRAGA<br>DRAGA<br>DRAGA<br>DRAGA                            |
| DRAGR             |                        | 1    | Partial drag mrt altitude                  | •          | /GENF       | 10        | 533)  | ACCEL<br>BL5<br>BL7<br>BL8<br>FH3<br>VT                                             | M<br>I<br>I<br>I<br>I | DRAGA DRAGR DRAGR DRAGR DRAGR DRAGR DRAGR                   |
| DRAGV             |                        | I    | Partial of drag wrt velocity               |            | /GENF       | 70        | 532)  | ACCEL<br>BL5<br>BL7<br>BL8<br>FH3<br>VT                                             | I<br>I<br>I<br>I      | DRAGV<br>DRAGV<br>DRAGV<br>DRAGV<br>DRAGV<br>DRAGV          |
| 6                 | g                      | I    | Gravitational attractson (F                | T/SEC**2)  | /GENF       | /(        | 301)  | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELA<br>PDY3A<br>SDER3<br>SDINP  |                       | 888888888888888888888888888888888888888                     |
| GH                |                        | 1    | Partial of gravity art altitude            |            | /GENF       | /(        | 563)  | BL7<br>BL8<br>EQUA3<br>PDY3A                                                        | I<br>O<br>I           | 6H<br>6H<br>6H<br>D6DH                                      |
| OMEGA             | ω                      | I    | Earth rotation rate                        | (RAD/SEC)  | /STATE      | 3/0       | 7,19) | BL4<br>BL7<br>TOPM                                                                  | I<br>I<br>O           | OMEGA<br>OMEGA<br>OMEGA                                     |
| OME GAZ           | , ω2                   | I    | See symbol                                 |            | /STATE      | 3/(       | 720)  |                                                                                     | I<br>I<br>I<br>O      | OMEGA:<br>OMEGA:<br>OMEGA:<br>OMEGA:                        |
| R                 | R                      | I    | Radial distance from earth center to vehic | ile (FT)   | / GENF      | /(        | 305)  | BL4<br>BL7<br>BL8<br>DER3A<br>EQUELA<br>MODELA<br>MODELA<br>POBC<br>POY3A<br>TRTOSZ | I                     | # # # # # # # # # # # # # # # # # # #                       |
| RO                | , <sup>6</sup> a       | I    | Atmospheric density (SLC                   | JGS/FT**3) | /GENF       | 70        | 309)  |                                                                                     | I<br>I                | RO<br>RO<br>RO<br>RO<br>RO<br>RO<br>RO                      |
| RDA               |                        | Ĭ    | Derly Of density ort alt.                  |            | /GENF       | /(        | 313)  | BL7<br>BL8                                                                          | I<br>I<br>I<br>I      | ROR<br>ROR<br>ROR<br>ROR<br>ROR                             |
| SIDAÉ             | sin(α-ε <sub>E</sub> ) | 1    | See symbol                                 |            | /GENF       | /(        | 557)  | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>VT                                      | I<br>I                | SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE |

| FORTRAN  | MATH    | CODE         | DESCRIPTION |        | STORA     | SE<br>LOC | SUBHOUTINE USAGE                                                                                                                                                            |
|----------|---------|--------------|-------------|--------|-----------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL   | SYMBOL  |              |             | ·      | BLOCK     |           | JUBN CODE TAN                                                                                                                                                               |
| SINA     | sinα    | I See symbol |             |        | /AEC03 /( | 7)        | ACCEL I SINA BLH I SINA BLG I SINA BLI I SINA BLB I SINA FH3 I SINA GUI3A M SINA OUT I SINA VT M SINA                                                                       |
| SINGAM . | \$1n(7) | I See symbol |             |        | /STATE3/( | 688)      | BL4 I SINGAM<br>BL7 I SINGAM<br>BL8 I SINGAM<br>DER3A I SINGAM<br>EQUA3 O SINGAM<br>MODELA I SINGAM<br>MODELA I SINGAM<br>POBC I SINGAM<br>PDY3A I SINGAM<br>SDER3 I SINGAM |
| SINPSI   | sìn(∳)  | I See symbol |             |        | /STATE3/( | 704)      | BL4 I SINPSI<br>BL7 I SINPSI<br>BL8 I SINPSI<br>DER3A I SINPSI<br>EQUA3 O SINPSI<br>MODELA I SINPSI<br>MODELB I SINPSI<br>PDBC I SINPSI<br>PDBC I SINPSI<br>PDBY3A I SINPSI |
| 5 I NRHO | sin(ρ)  | I See symbol |             |        | /STATE3/( | 706)      | BL4 I SINRHO<br>BL7 I SINRHO<br>BL8 I SINRHO<br>BER3A I SINRHO<br>EQUA3 O SINRHO<br>MODELA I SINRHO<br>OUT I SINRHO<br>PDBC I SINRHO<br>PDBC I SINRHO<br>POY3A I SINRHO     |
| SIN2RO   | sin(2ρ) | ∄ See sy≃bol |             |        | /STATE3/( | 755)      | BL4 I SIN2RO<br>BL7 M SIN2RO<br>BL8 M SIN2RO<br>MODELA O SIN2RO<br>MODELB O SIN2RO                                                                                          |
| T        | T       | I Thrust     |             | (LB\$) | /GENF /(  | 411)      | ACCEL I T BLGCON M T BL4 I T BL6 I T BL7 I T BL8 I T EL2 I T EQUAS O T FH1 I T FH2 I T FH2 I T FH4 I T FH4 I T IMPUL I T OUT PROPEN O T PROPEN O T REUS O T SDERS I T       |

| -ORTRAN<br>57MBOL | MATH   | COO | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                                     | 51084     |      | SUMBOUTIN                                                               |                                                                               |
|-------------------|--------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-----------|------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| 2 A LIBOT         | SYMBOL |     | 02001(11 110)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | · · · · · · · · · · · · · · · · · · · | BLOCK     | LÜL  | 508m L00                                                                | E VAR                                                                         |
| ¥                 |        | ī   | Relative velocity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (FT/SEC)                              | /STATE3/( | ٠    | ACCICES I I I I I I I I I I I I I I I I I I I                           | A X A X A X A X A X A X A X A X A X A X                                       |
| xk3               |        | 0   | Third control vector governing equations of the control vector in algebraic equations of the control of the co |                                       | /GENF /(  | 574) |                                                                         | x k 3<br>x k 3 |
| XK3A              |        | 9   | Partial of governing equation wrt state vector component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ate or control                        | /GENF /(  | 583) | BLGCON I<br>BL2 0<br>BL3 0<br>BL4 0<br>BL5 M<br>BL6 0<br>BL7 0<br>BL6 0 | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A                          |
| XK3D              |        | 0   | Partial of governing equation wrt stavector component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ate or control                        | /SENF /(  | 580) | BLGCON I<br>BL4 0<br>BL6 0<br>BL7 0<br>BL8 0                            | XK3D<br>XK3D<br>XK3D<br>XK3D<br>XK3D                                          |
| XK38              |        | 0   | Partial of governing equation wrt state vector component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ate or control                        | /GENF /(  | 589) | BL4 0<br>BL7 0<br>BL8 0                                                 | XK36<br>XK36<br>XK36                                                          |
| XK3M              |        | 0   | Partial of governing equation wrt stavector component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ate or control                        | /GENF /(  | 604) | BL4 0<br>BL5 M<br>BL6 0<br>BL7 0<br>BL8 0                               | XK3M<br>XK3M<br>XK3M<br>XK3M<br>XK3M                                          |
| XK30              |        | 0   | Partial of governing equation wrt state vector component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ate or control                        | /GENF /(  | 598) | BL4 0<br>BL7 0<br>BL8 0                                                 | XK30<br>XK30                                                                  |
| хкзр              |        | 0   | Partial of governing equation wrt stavector component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ate or control                        | /GENF /(  | 592) | BL4 0<br>BL7 0<br>BL8 0                                                 | XK3P<br>XK3P<br>XK3P                                                          |
| XK3R              |        | 0   | Partial of governing equation art stavector component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ate or contro!                        | /GENF /(  | 595) |                                                                         | XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R                                  |

| FORTRAN<br>SYMBOL | MATH<br>Symbol | CODE | DESCRIPTION                                                         | ST<br>BLGC | ORAG | LOC  | <u>SUBROU</u><br>SUBR                  |                  | USAGE<br>VAR                                 |
|-------------------|----------------|------|---------------------------------------------------------------------|------------|------|------|----------------------------------------|------------------|----------------------------------------------|
| XK3T              |                | 0    | Partial of governing equation mrt state or control vector component | /GENF      | /(   | 577) | BLGCON<br>BL4<br>BL6<br>BL7<br>BL8     | 1<br>0<br>0<br>0 | XK3T<br>XK3T<br>XK3T<br>XK3T<br>XK3T         |
| XK3A              |                | 9    | Partial of governing equation art state or control vector component | /GENF      | /(   | 586) | BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8 | 0<br>m<br>0<br>0 | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A |

| 34. COMMON/AE 35. *APHO 36. *SINA 37. *COSPHI 38. *CDOM 39. *CM 40. *CLAM 41. *CD 42. COMMON/ST 44. *XL(9,9) 45. *SINFSI 46. *SYBY 47. *VOY 48. *JUDY 49. *UDG 51. *GOP 52. *POO 53. REAL MOM 55. *SINZRO 60. REAL M, RI 60. REAL M, RI 61. COMMON/ST 62. C 63. C 64. 65. ASSIGN 66. ASSIGN 66. ASSIGN 66. GO TO 301 67. GO TO 301 68. ENTRY BLI 66. GO TO 301 68. ENTRY BLI 67. GO TO 301 68. ENTRY BLI 68. ENTRY BLI 69. ASSIGN 69.                                                                                                                                                                                                                                                                                                                                                                                                                         | OMSP(20,2) ACON(9) DT RE PAR TIMEPH TPH (20) LIFT FP     | ,BCON(9)<br>,G<br>,MACH<br>.GOR | TBL(9)<br>, COTI(9,9)<br>, DPSB<br>, PA | ,SVAR(10)<br>,BCON(9) | , WDC(2G)<br>, DTP                           | , GEA      |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------|-----------------------------------------|-----------------------|----------------------------------------------|------------|------|
| 7. *VNU 8. *SYSQ 9 *TIST(20) 10 *TLP1(20) 11. *ITPR 12. *AE 13. *QR 14. *LIFTR 15. *CULFT 16. *CULFT 17. *COD 10. *CULFT 18. *CULFT 19. *COD 20. *COMMON / FRATEB 22. *FRATEB 23. *FRATEB 24. *XXIR 25. *XXIR 26. *XXIR 27. *XXIR 28. *XXIV 29. *PY 21. *XXIR 28. *XXIV 29. *PY 30. REAL LIFT 28. *XXIV 29. *PY 40. *SIMA 31. *ISP 33. *COMMON/AF 33. *COMMON/AF 34. *COMMON/AF 35. *APHO 36. *SIMA 37. *COSPHI 38. *COMMON/AF 38. *COMMON/AF 39. *CHM 40. *CLAM 41. *XUO9 42. *COMMON/AF 44. *XI(9,9) 45. *SYNV 46. *SYNV 47. *VOV 48. *COMMON/AF 49. *COMMON/AF 49. *COMMON/AF 40. *COMMON/AF 41. *XI(9,9) 45. *SYNV 46. *SYNV 47. *VOV 48. *COMMON/AF 49. *COMMON/AF 49. *COMMON/AF 40. *COMMON/AF 40. *COMMON/AF 41. *XI(9,9) 45. *SYNV 46. *COMMON/AF 47. *VOV 48. *COMMON/AF 49. *COMMON/AF 49. *COMMON/AF 49. *COMMON/AF 49. *COMMON/AF 40. *COMMON/AF 40. *COMMON/AF 40. *COMMON/AF 41. *COMMON/AF 42. *COMMON/AF 43. *COMMON/AF 44. *XI(9,9) 45. *COMMON/AF 46. *COMMON/AF 47. *COMMON/AF 48. *COMMON/AF 49. *COMMON/AF 49. *COMMON/AF 49. *COMMON/AF 40.                                                                                                                                                                                                                                                                                                                                                                                                                         | ,DI<br>,RE<br>,PAR<br>,TIMEPH<br>,TPH (20)<br>,TLS) (20) | , MACH<br>- ROR                 | DA                                      | å                     | 1=2.                                         |            |      |
| 6. *R 7. *VNU 8. *SYSQ 9 *TITIC20) 1. *IIPPR 3 *QR 1. *IIFTR 3 *QR 4 *LIFTR 5. *XMCG 8. *CULFT 9 *COD 0 COMMON / 1. *XXI 9 *FRATED 3 *PI 1. *XXI 5 *XXI 6. *XXI 6. *XXI 6. *XXI 7. *XXI 8 *XXI 9. *REAL LIFTR 9. *XXI 8 *XXI 9. *REAL LIFTR 9. *XXI 9. *COMMON / 1. *XXI 9. *X                                                                                                                                                                                                                                                                                                                                                                                                                         | , HE<br>, PAR<br>, TIMEPH<br>, TPH (20)<br>, TLS) (20)   | ,MACH<br>.ROR                   |                                         |                       | 115                                          | GEN        |      |
| 8. *SYSQ 9 *TIFI(20) 1. *TIPI(20) 2. *AE 3 *QRT 6. *XING 8 *CULFT 9 *CULFT 1 * *XXIG 1                                                                                                                                                                                                                                                                                                                                                                                                                         | ,TIMEPH<br>,TPH (20)<br>,TLS1 (20)                       | -606                            | ,                                       | . KO                  | 125                                          | , GEA      |      |
| TIST(20) TIPME TIST(20) TIPME                                                                                                                                                                                                                                                                                                                                                                                                                          | TLS1 (20)                                                |                                 |                                         | _VNR                  |                                              | , GEA      |      |
| TP1   120                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | .1651 (20)                                               | TIMES                           |                                         | ,105                  | ,TR(9)                                       | , GEN      |      |
| 1. *ITOPR 2. *AE 3 *QR 4 *LIFTR 5. *XMCG 8. *CULFT 6. *XMCG 8. *CULFT 9 *COD 1. *XJV 2. *FRATED 3 *PI 2. *FRATED 3 *PI 4 *XK1A 5 *XK1B 6 *XK1B 7 *XK1B 8 *XK1B 9 *COMMON/ST 1 *DOV 9 *COMMON/ST 1 *COMMO                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | ),BIS(20)<br>),BIP1(20)         | DIP(20)                                 | ,TIME                 | , u<br>, order                               | CEN        | ie l |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          | NEAC                            | ιΔI                                     | _ TRUBN               | ,TBU(20)                                     | BEN        |      |
| *LIFTR  6. ** 7 ** XMCG  7 ** XMCG  8 ** CULFT  9 ** COB  1. ** XJY  2. ** FRATED  3 ** PRITED  4 ** XKITA  8 ** XKITA  8 ** XKITA  8 ** XKITA  9 ** PP  1 ** ISP  2 ** APHO  4 ** APHO  5 ** APHO  6 ** SINA  7 ** COSPHI  ** COSPHI  ** COMMON/ST  8 ** COSPHI  ** COMMON/ST  9 ** VOV  9 ** COMMON/ST  6 ** SINA  1 ** COMMON/ST  6 ** SINA  1 ** COMMON/ST  6 ** SINA  7 ** VOV  9 ** UDG  1 ** COMMON/ST  6 ** SINA  6 ** COMMON/ST  7 ** (VAR(5))  9 ** COMMON/ST  8 ** COMMON/ST  1 ** COMMON/ST  1 ** COMMON/ST  8 ** COMMON/ST  9 ** COMMON/ST  1 ** COMMON/ST  1 ** COMMON/ST  8 ** COMMON/ST  9 ** COMMON/ST  1 ** COMMON/ST  1 ** COMMON/ST  8 ** COMMON/ST  1 ** COMMON/ST  8 ** COMMON/ST  1 ** COMMON/ST  8 ** COMMON/ST  1 ** COMMON/ST  1 ** COMMON/ST  8 ** COMMON/ST  1 ** COMMON/ST  2 ** COMMON/ST  2 ** COMMON/ST  3 ** COMMON/ST  4 ** COMMON/ST  4 ** COMMON/ST  2 ** COMMON/ST  3 ** COMMON/ST  4 ** COMMON/S                                                                                                                                                                                                                                                                                                                                                                                                                         | ,FP                                                      | .FPULU                          |                                         | MACHR                 | MACHY                                        | GEN        | IF . |
| 5. * 7 * XMCG 8. * CUDF 9 * CODF 1. *XJY 2. *FRATED 3 *P1 1. *XK1A 6. *XK1A                                                                                                                                                                                                                                                                                                                                                                                                                         | _ 44                                                     | FVAC                            | , L1+14                                 |                       | •                                            | GEN        |      |
| 6. * * MCG 8. * CULFT 90 * COB 11. * XJV 12. * FRATED 3 * P1 15 * XK1A 6. * XK1A 8 * XK1A 8 * XK1A 91. * YV 15 * XK1A 15 * XK1A 16 * XK1A 17 * XK1A 18 * XK1A 19 * XK1A 10 * XK1A 11 * COMMON/ST 11 * COMMON/ST 12 * YUBY 13 * XUBY 14 * XUBY 15 * XUBY 16 * XUBY 17 * XUBY 18 * YUBY 19 * YUBA 10 * XUBA 10 * XUBA 10 * XUBA 11 * XUBA 11 * XUBA 11 * XUBA 12 * YUBA 13 * XUBA 14 * XUBA 15 * XUBA 16 * XUBA 17 * XUBA 18 * XUBA 18 * XUBA 19 * XUBA 19 * XUBA 10 * XUBA 11 * XUBA 11 * XUBA 11 * XUBA 12 * YUBA 13 * XUBA 14 * XUBA 15 * XUBA 16 * XUBA 17 * XUBA 18 * XUBA 18 * XUBA 19 * XUBA 19 * XUBA 10 * XUBA 11 * XUBA 11 * XUBA 11 * XUBA 12 * XUBA 13 * XUBA 14 * XUBA 15 * XUBA 16 * XUBA 17 * XUBA 17 * XUBA 18 * XUB                                                                                                                                                                                                                                                                                                                                                                                                                         | LILIB                                                    | 1,00                            | UNHQY                                   | ,ORAGR                | DRAGA<br>ISPF                                | , GEN      |      |
| 7 * XMCG 8. *CULFT 9 * COPMON / 1. *XJV 2. *FRATED 3 *P1 4 * XK1A 6. * XK1G 7. * XK1G 8 * XK1G 8 * XK1G 8 * XK1U 9 * PV 1 * ISSP 1 SING 1 * ISSP 1                                                                                                                                                                                                                                                                                                                                                                                                                          | LIFTM                                                    | ,DBR<br>ULFT                    | , DB                                    | ISP                   | DETA                                         | , GEN      |      |
| 8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | , XMCGV                                                  | XMCGR                           | ULFTV<br>XMCGA                          | ,ULFTR<br>,XMCGM      | ULFTA<br>CODAE                               | CEL        |      |
| 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CT CT                                                    | CALPHA                          | CDE                                     | DELTAE                | ,SIB                                         | , GEN      | F    |
| 1. *XJYTED  2. *FRATED  3 *P1  4 *XKIT  5 *XKIG  7 *XKIG  8 *XKIG  8 *XKIG  8 *XKIG  8 *XKIG  1 * ISP  1 * COMMINATE  4 * APHO  4 * COSPHI  * COSPHI  * COMMINATE  5 * APHO  6 * SINA  7 * COSPHI  * COMMINATE  6 * SINA  7 * COSPHI  * COMMINATE  6 * SINA  7 * VOR  9 * UDR  1 * COMMINA  1 * SYBY  9 * UDR  1 * SYBY  9 * UDR  1 * COMMINA  2 COMMINA  1 * COMMINA  1 * COMMINA  1 * COMMINA  2 COMMINA  4 * COMMINA  5 * COMMINA  6 * COMMINA  6 * COMMINA  7 * COMMINA  6 * COMINA  6 * COMMINA  6 * COMMINA  6 * COMMINA  6 * COMMINA  6 * COMINA  6 * COMMINA  6 *                                                                                                                                                                                                                                                                                                                                                                                                                          | CT<br>SIDAE                                              | XCE                             | , 206                                   | , X.J                 | ,                                            | GEA        | (F   |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | GÉNF /                                                   |                                 |                                         |                       |                                              | GEN        |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | , XJR                                                    | , eh                            | , GAMMAD                                | ,xk <del>G</del>      | , KKP                                        | , GEN      |      |
| 4 *XK1T<br>5 *XK1A<br>6. *XK1G<br>7. *XK1R<br>8 *XK1U<br>9. *PY<br>1 * ISP, ISP<br>1 * ISP, ISP<br>2 * DIMENSION<br>1 * COMMON/AE<br>*SINA<br>*COSPHI<br>*CDOM<br>8. *CDOM<br>1 *CDOM<br>1 *CDOM<br>1 *CDOM<br>1 *CDOM<br>2 *COMMON/ST<br>*SINPS<br>1 *XL(9,9)<br>5 *SINPS<br>6 *SINPS<br>1 *SINPS<br>6 *SINPS<br>6 *SINPS<br>1 *SINPS<br>6 *SINPS<br>6 *SINPS<br>7 *VBV<br>8 *UDV<br>8 *UDV<br>8 *UDV<br>9 *UDDP<br>*SINPS<br>1 *COMMON/ST<br>*SINPS<br>6 *SINPS<br>6 *SINPS<br>1 *COMMON/ST<br>*SINPS<br>1 *COMMON/ST<br>*SINPS<br>1 *COMMON/ST<br>*SINPS<br>1 *SINPS<br>1 *SINPS<br>2 *SINPS<br>1 *SINPS<br>2 *SINPS<br>1 * | , IRATED                                                 | ,P3                             | VKI                                     | 442                   | 443                                          | GEN        |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ,xk2T                                                    |                                 | , XK1<br>, XK1D                         | XK2<br>XK2D           | , XK3<br>, XK3D                              | CCV        |      |
| 7. *XKIR<br>8 *XKIU<br>9. *XKIU<br>9. *REAL LIF<br>1 * ISP, ISP<br>2 DIMENSION<br>3. *COUNT AND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                          | XXXA                            |                                         | X K Z W               |                                              | , GEA      | ΪF   |
| 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | , XK26                                                   | , 1636                          | ZKIÐ                                    | 2 E 7 P               | 38.3P                                        | . GEN      | IF . |
| 9. PY 10. REAL LIF 11 * ISP ISP 21 DIRENSION 22 DIRENSION 33 EQUIVAL 44 COMMON/AE 45 * APHO 46 * SINA 47 * CDSPHI 48 * * CDOM 49 * CDM 40 * CDM 50 * CDM 40 * CDM 40 * CDM 50 * CDM 40 * CDM 50 * CDM 50 * CDM 60                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                          | . XK3H                          |                                         |                       | - 4820                                       | . GEA      | E    |
| 0- REAL LIF 1 * ISP. ISP. 2 DIMENSION 3- EQUIVALE 5- *APHO 6 *SINA 7- *CDSPHI 8- *CDOM 9- *CLAM 1 *CD 2 COMMON/SI 4- *XH(9-9) 5- *SINPSI 4- *SUBY 9 *UDG 8 *UDY 9 *UDG 1 *SOP 1 *SOP 2 *PDO 3 *REAL MAN 1 *COMMON/SI 1 *SOP 9 *UDG 1 *SOP 1 *SOP 1 *SOP 2 *POO 3 *COMMON/SI 1 *COMMON/SI 1 *COMMON/SI 1 *COMMON/SI 1 *COMMON/SI 1 *COMMON/SI 2 *COMMON/SI 3 *COMMON/SI 4 *COMMON/SI 5 *COMMON/SI 6 *COMMON/SI 6 *COMMON/SI 7 *(COMMON/SI 8 *COMMON/SI 8 *COMMON/SI 9 *COMMON/SI 1 *COMMON                                                                                                                                                                                                                                                                                                                                                                                                                         | , XXZÜ<br>.PG                                            | , XK3U<br>, PP                  | . XN 141                                | - X&ZB                | , X&379                                      | , GEA      |      |
| 1 * JSP ISS 2 SEC 2 DIMENSION 3. EQUIVALEM COMMON/SE ** SINA ** COSPHI ** COMMON/SE ** COMMON/SE ** COMMON/SE ** COMMON/SE ** COSPHI **                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                          | ITETA LIET                      | PR                                      | ,PO MACH,             | ,DPDY(3,8)                                   | GEN        |      |
| 3. EQUIVALES 5. *APHO 6. *SINA 7. *CDSPHI 8. *CDSPHI 8. *CDSPHI 9. *CM 10. *CLAM 11 *CD 2 *COMMON/SI 3. *VAR(14) 4. *XL(9,9) 5. *SINFSI 6. *SVBV 8 *UDY 9 *UDR 11 *GDP 23 *FEAL MDM 12 *GDP 24 *COMMON/SI 55 *SINCA 6 *SSIGN 6 *COMMON/SI 7 *(VAR(6) 8 *(DVAR(6)) 9 *(DVAR(6)) 10 *COMMON/SI 11 *COMMON/SI 12 *COMMON/SI 13 *COMMON/SI 14 *COMMON/SI 15 *COMMON/SI 16 *COMMON/SI 17 *COMMON/SI 18 *COMMON/SI 19 *COMMON/SI 10 *COMMON/SI 11 *COMMON/SI 12 *COMMON/SI 13 *COMMON/SI 14 *COMMON/SI 15 *COMMON/SI 16 *COMMON/SI 17 *COMMON/SI 18 *COMMON/SI 19 *COMMON/SI 10 *COMMON/SI 11 *COMMON/SI 12 *COMMON/SI 13 *COMMON/SI 14 *COMMON/SI 15 *COMMON/SI 16 *COMMON/SI 17 *COMMON/SI 18 *COMMON/SI 19 *COMMON/SI 10 *COMMON/SI 10 *COMMON/SI 11 *COMMON/SI 12 *COMMON/SI 13 *COMMON/SI 14 *COMMON/SI 15 *COMMON/SI 16 *COMMON/SI 17 *COMMON/SI 18 *COMMON/                                                                                                                                                                                                                                                                                                                                                                                                                         | F MACHVILIT                                              | LIFTA, LIFTA<br>FIV , IRAYES    | 7,                                      | maca,                 | mom,                                         | FR         |      |
| 3. EQUIVALES 4. COMMON/AE 5. *APHO 6. *SINA 7. *CDSPHI 8. *CDSPHI 8. *CDSPHI 9. *CM 1. *CD 2. *CLAM 1. *CD 2. *CAMMON/SI 5. *SINFSI 6. *SVBV 8. *UDY 9. *UDR 1. *GOP 2. *PDO 3. REAL MOM 1. *GOP 3. *COMMON/SI 6. *SINCA 6. *SSIGN 6. *SSIGN 6. *ASSIGN 6. *ASSIGN 7. *GOTTON 8. *COMMON/SI 8. *COMMON/SI 9. *COMMON/SI 1. *COMMON/SI 1. *COMMON/SI 1. *COMMON/SI 2. *COMMON/SI 3. *C 4. *COMMON/SI 4. *COMMON/SI 5. *SIRN 6. *COMMON/SI 6. *COMMON/SI 6. *COMMON/SI 7. *COMMON/SI 8. *COMMON/SI 8. *COMMON/SI 9. *COMMON/SI 1. *COMMON/                                                                                                                                                                                                                                                                                                                                                                                                                         | 1 TPH1(10) TS                                            | ST1(10)                         | •                                       |                       |                                              | GEA        | F    |
| 5. *APHO 6 *SINA 7. *CDSPHI 9. *CDON 90. *CLAM 11 *CD 21 *COMMON/SI 32 *VAR(14) 41 *XL(9,9) 55 *SINFSI 6 *SYBV (9,9) 56 *SYBV (9,9) 57 *VDV 88 *UDY 90 *UDR 11 *GOP 22 *PDO 23 *REAL MOM 24 *COMMON/SI 55 *SINZNO 66 *EQUIVALEN 77 *(VAR(1),9) 88 *(DYAR(1),9) 89 *(DYAR(1),9) 10 *COMMON/SI 10 *COMMON/SI 11 *COMMON/SI 12 *COMMON/SI 12 *COMMON/SI 13 *COMMON/SI 14 *COMMON/SI 15 *COMMON/SI 16 *COMMON/SI 17 *COMMON/SI 18 *COMMON/SI 19 *COMMON/SI 10 *COMMON/SI 11 *COMMON/SI 12 *COMMON/SI 13 *COMMON/SI 14 *COMMON/SI 15 *COMMON/SI 16 *COMMON/SI 17 *COMMON/SI 18 *COMMON/SI 19 *COMMON/SI 10 *COMMON/SI 10 *COMMON/SI 11 *COMMON/SI 12 *COMMON/SI 13 *COMMON/SI 14 *COMMON/SI 15 *COMMON/SI 16 *COMMON/SI 17 *COMMON/SI 18 *COMMON/SI 19 *COMMON/SI 10 *COMMON/                                                                                                                                                                                                                                                                                                                                                                                                                         | ICE(TLP1,TPH)                                            | 1),(TLS1,TST                    | <b>[1]</b>                              |                       |                                              | GEN        |      |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | C03/                                                     |                                 |                                         |                       |                                              | AEC        |      |
| 7. *COSPHI<br>8. *CDOM<br>9. *CLAM<br>1. *CD<br>1. *CD<br>2. COMMON/SI<br>3. *VAR(14)<br>4. *XL(9,9)<br>5. *SINPSI<br>6. *SYBV (9,0)<br>8. *UDV<br>8. *UDV<br>9. *UDR<br>1. *GOP<br>9. *UDR<br>1. *GOP<br>1. *GOP<br>2. *PDD<br>3. REAL MOM<br>4. COMMON/SI<br>5. *SINPRO<br>6. *SINPRO<br>6. *COVAR(1),9<br>9. *COVAR(1),9<br>9. *COVAR(1),9<br>1. *COMMON/SI<br>1. *COMMON/SI<br>8. *COVAR(1),9<br>9. *COVAR(1),9<br>1. *COMMON/SI<br>1. *COMMON/SI<br>2. *COMMON/SI<br>3. *COMMON/SI<br>4. *COMMON/SI<br>4. *COMMON/SI<br>5. *COMMON/SI<br>6. *COMMON/SI<br>7. *COMMON/SI<br>6. *COMMON/SI<br>7. *COMMON/SI<br>8.                                                                                                                             | , APHR<br>, COSA                                         | ,ALPHA                          | , VOA<br>, PHID                         | , SDA                 | ,PBA                                         | , AEC      |      |
| 8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | GDPH                                                     | ,PHIO<br>,POPH                  | ,XLAMA(9)                               | ,PHI<br>,XLAMP(9)     | ,SIMPHI<br>,CDO                              | , VEL      |      |
| 9. CM 1. *CLAM 1. *CLAM 1. *CLAM 2. *CDMHDN/ST 2. *VAR(14) 4. *XL(9,9) 5. *SINPS 6. *SVBV 7. *VDV 8 *UDV 8 *UDV 9 *UDG 1. *GDP 2. *PDD 3. REAL MDM 5. *SINZNO 6 *EQUIVALEN 7. *(DVAR(1)) 9 *(DVAR(1)) 9 *(DVAR(1)) 9 *(DVAR(1)) 1. *COMMON/ST 1. *COMMON/ST 2. *COMMON/ST 3. *COMMON/ST 4. *COMMON/ST 4. *COMMON/ST 5. *SISION 31 6. *ASSIGN 41 6. *ASSIGN 41 6. *ASSIGN 41 6. *ASSIGN 41 7. *GO TO 301 8 *ENTRY BL 7. *GO TO 301 8 *ENTRY BL 7. *GO TO 301 8 *ASSIGN 41 8 *                                                                                                                                                                                                                                                                                                                                                                                                                         | CIO                                                      | FK                              | ICSM                                    | 7 C S B               | LLOM                                         | AET        |      |
| 0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | I COD                                                    | LEAR LEAR                       | CRO                                     | CHOM                  | ,FKH                                         | , AEC      |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | , li L                                                   | , LLM                           | CLH                                     | ;                     | •                                            | AEC        | 83   |
| 3. *VAR(14) 4. *XL(9,9) 5. *SINFS) 6 *SVBV (5 7. *VDV 8 *UDY 9 *UDR 1 *GDP 1 *GDP 2 *PDD 3 REAL MDM 4 COMMON/ST 5. *SINZRO 6 EQUIVALEN 7 *(VAR(5),9 8 *(DYAR(1),9 0. REAL M,RI 1 COMMON/ST 2 C FLIGG 3. C 5. ASSIGN 44 6. ASSIGN 47 7. GD TO 301 8 ENTRY BL7 7. STRY BL7 7. GD TO 301 8 ENTRY BL7 8 SINTRY BL7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | . เบค                                                    | , COM                           | •                                       | -                     |                                              | AEC        |      |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | RIES/                                                    | . WARL (80)                     | 00401 / 00 3                            | HO1 6 3               | ENVISA                                       |            | TE3D |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ,DYAR (14)                                               | VRS (20 4)                      | DVARL(99)                               | , YD(9)<br>, SINGAM   | ,54Y(10)<br>,5AVBF(15)                       | CTA        | TE3D |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ,cosesi ,                                                | .SIMKHU                         | ,COSRHO                                 | ,ocorno               | ,OCORO2                                      |            | TESD |
| 7. *VOV<br>8 *UDG<br>9 *UDG<br>9 *UDG<br>1 *SDP<br>2 *PDO<br>3 REAL MOM<br>4 COMMON/55<br>5- *SINZRO<br>6 EQUIVALEN<br>7 *(VAR(5),<br>8 *(DVAR(6),<br>9 *(DVAR(6),<br>10 COMMON/55<br>11 COMMON/55<br>12 C FLIG<br>13 C<br>14 ENTRY BL<br>45 ASSIGN 41<br>6 ASSIGN 41<br>6 ASSIGN 41<br>7 GO 10 301<br>8 ENTRY BL<br>7 GO 10 301<br>8 ENTRY BL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | )) DAFRA                                                 | .DMFRAZ                         | =                                       | _                     | ,                                            |            | TEBB |
| 9 *** UDG 0 *** UDR 1 *** SDP 2 *** PDD 2 *** PDD 3 REAL MDM 4 COMMON/ST 5 *** SINZRO 6 EQUIVALE 7 **(VAR(5), P 8 **(DVAR(1), P 9 **(DVAR(1), P 1 COMMON/SG 1 C 1 C FLIG 1 ENTRY BL 6 ASSIGN 36 7 GO 10 301 8 ENTRY BL 9 ASSIGN 57                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | .60V                                                     | .RDV                            | MDV                                     | ,PDV                  | , anv                                        |            | TE30 |
| 0 *UDR 1 *GDP 2 *PDD 3 REAL MDM 4 COMMON/51 5 *SINZRO 6 EQUIVALEN 7 *(VAR(1)) 9 *(DVAR(1)) 1 COMMON/51 1 COMMON/55 2 C FLIGG 4- 5 ASSIGN 40 6. ASSIGN 40 7. GD TO 301 8 ENTRY BL3 9 ASSIGN 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | _ ¥116-                                                  | .606                            | . KBa                                   |                       | ากด                                          | , STA      | TE30 |
| 1 *60P 2 *PD0 3 REAL MDM 4 COMMON/55 - *SINZRO 6 EQUIVALEN 7 *(VAR(5), P 8 *(DVAR(6), P 9 *(DVAR(6), P 1 COMMON/55 1 C FLIG 3 C 4 ENTRY BL 5 ASSIGN 41 6 ASSIGN 41 7 GO TO 301 8 ENTRY BL 8 ASSIGN 81 9 ASSIGN 81                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | , VDR<br>, VDM                                           | , 60B                           | AIIK                                    |                       | ,,008                                        | CTE        | TESD |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | PRP                                                      | GDA<br>DDP                      | , MDM<br>, UDP                          | , PDA<br>, VDD        | , VDP<br>, 600                               | " STA      | TE3D |
| 3 REAL MOM 4 COMMON/ST 5- *SINZRO 6 EQUIVALEN 7 *(VARC5),8 8 *(DVARC1),9 9 *(DVARC6) 1 COMMON/ST 1 COMMON/ST 1 COMMON/ST 2 C FLIG 4- ENTRY BL 5- ASSIGN 41 6- ASSIGN 41 7- GO TO 301 8 ENTRY BL 9 4 ASSIGN 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | , 000                                                    | HIBY                            | HTOR                                    | ,,,,,,                | ,                                            |            | TE3D |
| 4 COMMON/ST 5 *\$1N2RO 6 EQUIVALEN 7 *(VAR(5), 9 9 *(DVAR(6), 0 REAL M, M; 1 COMMON/SE 2 C FLIGH 3 C FLIGH 4 ENTRY BL7 7 GO TO 301 8 ENTRY BL7 8 ASSIGN 46 8 ASSIGN 47 8 ASSIGN 57                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | , HUY, HUK                                               | ,                               | ,                                       |                       |                                              |            | TE30 |
| 5. *SINZRO 6 EQUITVALER 7 *(VAR(5), 8 8 *(DVAR(1), 9 9 *(DVAR(6), 1 1 COMMON 1 1 COMMON 1 2 C FLIGH 4. ENTRY BL3 5 ASSIGN 44 6. ASSIGN 45 6. ASSIGN 47 7. GO TO 301 8 ENTRY BL3 9 ASSIGN 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | DTF3/                                                    |                                 |                                         |                       |                                              | STA        | TE3D |
| 8 *(DYARC1), 9 *(DYARC1), 1 COMMON/SF 2 C FLIGG 4- ENTRY BL7 5 ASSIGN 40 6. ASSIGN 47 7- GD TD 301 8 ENTRY BL7 9 ASSIGN 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CASSED                                                   | , CO5264                        |                                         | <del>.</del>          | MARIE (1. 1. 11. 11. 11. 11. 11. 11. 11. 11. | ST         | TE30 |
| 8 *(DYARC1), 9 *(DYARC1), 1 COMMON/SF 2 C FLIGG 4- ENTRY BL7 5 ASSIGN 40 6. ASSIGN 47 7- GD TD 301 8 ENTRY BL7 9 ASSIGN 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | IUE (VAR(1),\                                            | /} ,(VAH(2),                    | , GAR) (VAR(                            | 3), ALI) ,(           | VANCA), A)                                   | EOL        |      |
| 0. REAL M, MI 1 COMMON/SE 2 C FLIGG 4. ENTRY BL: 5 ASSIGN 46 6. ASSIGN 47 7. GO TO 301 8 ENTRY BL: 9 ASSIGN 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | DII, (BUARLO),                                           | ,680 J, L V4H( )                | 11,001,EVARE                            | . tin, to.            | THREY 5, 504),                               | EQ.        |      |
| 0. REAL M, M, 1 1 COMMON/SF 2 C FLIGG 4- ENTRY BL7 5 ASSIGN 44 6. ASSIGN 47 7- GD TD 301 8 ENTRY BL7 9 ASSIGN 57                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DD) ( DVARC 7                                            | ).U0).(DVAR                     | (8) HTn1 (8)                            | IAR( 9) . 5021        | ))<br>                                       | EDI        |      |
| 2 C FLIGH<br>3. C<br>4. ENTRY BLT<br>6. ASSIGN 30<br>7. GO TO 30<br>8 ENTRY BL<br>9 ASSIGN 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | J. MD                                                    | . , ,                           |                                         |                       |                                              | Eoi        |      |
| 2 C FLIGH<br>3. C<br>4. ENTRY BLT<br>6. ASSIGN 30<br>7. GO TO 30<br>8 ENTRY BL<br>9 ASSIGN 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ECO / UMU2,F                                             | AORR                            |                                         |                       |                                              | BL         | 7    |
| 4. ENTRY BLT<br>5 ASSIGN 40<br>6. ASSIGN 30<br>7. GD TD 30<br>8 ENTRY BLT<br>9 ASSIGN 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | IT MODE CONST                                            | RAINT                           |                                         |                       |                                              | BL         |      |
| 5 ASSIGN 40<br>6. ASSIGN 30<br>7. GO TO 301<br>8 ENTRY BLT<br>9 ASSIGN 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1010                                                     |                                 |                                         |                       |                                              | BL         |      |
| 6. ASSIGN 36<br>7. GO TO 301<br>8 ENTRY BLT<br>9 ASSIGN 56                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                          |                                 |                                         |                       |                                              | BL7        |      |
| 7. GO TO 301<br>B ENTRY BLT<br>9 ASSIGN 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 7. 10 100<br>7. 10 100                                   |                                 |                                         |                       |                                              | BL.        |      |
| B ENTRY BLT<br>9 ASSIGN 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                          |                                 |                                         |                       |                                              | BL7        |      |
| 9 ASSIGN 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          |                                 |                                         |                       |                                              | BL         |      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | TO 160                                                   |                                 |                                         |                       |                                              | BL7        | 7    |
| 0. GD TO 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | )1                                                       |                                 |                                         |                       |                                              | BL7        | 7 [3 |
| ENTRY BL7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          |                                 |                                         |                       |                                              | BL7        |      |
| 2. ASSIGN 60<br>3. C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 10 180                                                   |                                 |                                         |                       |                                              | 8L7<br>8L7 |      |
| 4 301 RDOT = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          |                                 |                                         |                       |                                              | BLI        |      |

20 DCT 72 6.01-46

20 001 72 6 01-46

## SUBRØUT I NE BL8

| FORTRAN<br>SYMBOL | MATH<br>Symbol               | CODE           | DESCRIPTION           |       | STORAGE<br>BLOCK | LOC  | <u>Suarou</u><br>Subr                                                             | TINE                                                                                        | USAGE                                                                                                      |
|-------------------|------------------------------|----------------|-----------------------|-------|------------------|------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
|                   |                              |                |                       |       |                  |      |                                                                                   |                                                                                             |                                                                                                            |
| CODAE             | c σ s ( α - δ <sub>E</sub> ) | I See symbol   |                       |       | /GENF /(         | 549) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>SDER3<br>VT                           | 1<br>1<br>1<br>I<br>I<br>I                                                                  | CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE                                       |
| COSA              | C Ð 5 ∝                      | I See symbol   |                       |       | /AEC03 /(        | 8)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>OUT<br>VT                             | I<br>]<br>]<br>I<br>I<br>]                                                                  | COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA                                               |
| COSGAM            | cos(7)                       | I See symbol   |                       |       | /STATE3/(        | 687) | ACCEL<br>BL4<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>OUT<br>PDBC<br>PDY3A | 1<br>1<br>1<br>0<br>1<br>1<br>1<br>1                                                        | COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM                     |
| COSPSI            | c a s ( <b> </b>             | I See symbol   |                       |       | /STATE3/(        | 705) | BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>PDBC                          | 1<br>1<br>0<br>1<br>1                                                                       | COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI                     |
| COSRHO            | cos(ρ)                       | I See sy≡bo!   |                       |       | /STATE3/(        | 707) |                                                                                   | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1                                                        | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO |
| COSZRO            | cos(2ρ)                      | M See symbol   |                       |       | /STATE3/(        | 756) | BL4<br>BL7<br>BL8<br>MODELA<br>MODELB                                             | M<br>M<br>0                                                                                 | COS2RO<br>COS2RO<br>COS2RO<br>COS2RO<br>COS2RO                                                             |
| DB                | D <sub>b</sub>               | I Base drag    |                       | (LBS) | /GENF /(         | 537) | ACCEL<br>BL6<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>OUT<br>SDER3<br>VT           | I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I | DB                                                                           |
| DBR               |                              | I Partial of b | ase drag ørt altitude |       | /GENF /(         | 536) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>VT                           | I<br>I<br>I<br>I                                                                            | DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR                                                       |

| FORTRAN<br>Symbol | MATH<br>SYMBOL | CODE            | DESCRIPTION               |              | ST<br>BLOCK | ORAGE<br>L | . 0 C | SUBROUT<br>SUBR C                                              | INE USAC<br>ODE VAI                                            |
|-------------------|----------------|-----------------|---------------------------|--------------|-------------|------------|-------|----------------------------------------------------------------|----------------------------------------------------------------|
| DRAG              | D              | l Aerodynamic d | rag                       | (LBS)        | /GENF       | /(         | 497)  | BL7<br>BL8<br>ENVPHM<br>FH3<br>OUT<br>PROPB<br>PROPIN<br>SOER3 | I DRAG<br>I DRAG<br>O DRAG                                     |
| DRAGA             |                | I Partial of dr | ag wrt angle of attack    |              | /GENF       | 10         | 534)  | BL5<br>BL7<br>BL8<br>FH3                                       | I DRAGA<br>I DRAGA<br>I DRAGA<br>I DRAGA<br>I DRAGA<br>M DRAGA |
| DRAGR             |                | I Partial drag  | ørt altitude              |              | /GENF       | 70         | 533)  | BL5<br>BL7<br>BL8<br>FH3                                       | I DRAGE<br>I BRAGE<br>I DRAGE<br>I DRAGE<br>M DRAGE            |
| DRAGV             |                | I Partial of dr | ag mrt velocity           |              | /GENF       | /(         | 532)  | BL5<br>BL7<br>BL8<br>FH3                                       | I DRAG'<br>I DRAG'<br>I DRAG'<br>I DRAG'<br>I DRAG'<br>M DRAG' |
| 6                 | g              | î Gravitational | attraction                | (FT/SEC**2)  | /GENF       | /(         | 301)  | BL7 BL8 DER3A EQUA3 MODELA MODELB PDY3A SDER3                  | I 6<br>I 6<br>I 6<br>I 6<br>I 6<br>I 6<br>I 6<br>I 6           |
| GH                |                | ) Partial of gr | avity wrt altitude        |              | /GENF       | /(         | 563)  | BL7<br>BL8<br>EQUA3                                            | I 6H<br>I 6H<br>O GH<br>I DGDH                                 |
| м                 | Œ              | i Mass          |                           |              | /STATE      | 3/(        | 4)    | BL4<br>BL8<br>EQUA3<br>OUT                                     | I M<br>I M<br>I M<br>I M<br>I M                                |
| OMEGA2            | ω <sup>2</sup> | I See sy≋bol    |                           |              | /STATE      | 3/(        | 720)  | BL7<br>BL8                                                     | I OMEGA<br>I OMEGA<br>I OMEGA                                  |
| R                 | R              | I Radval distan | ce from earth center to v | vehicle (FT) | /GENF       | /(         | 305)  | BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB               | I R<br>I R<br>I R                                              |

| FORTRAN  | MATH                   |   |                           |               |           | STORAGE |                                                                                   |                            | USAGE                                                                                            |
|----------|------------------------|---|---------------------------|---------------|-----------|---------|-----------------------------------------------------------------------------------|----------------------------|--------------------------------------------------------------------------------------------------|
| SYMHOL   | SYMBOL                 |   | DESCRIPTIO                |               | BLOCK     | LOC     | SUBR                                                                              | COD                        | RAV                                                                                              |
| RO       | ۰,                     | I | Atmospheric density       | (SLUGS/FT**3) | /GENF /(  | 309)    | BL7<br>BL8<br>DER3A<br>EQUA3<br>OUT<br>PDBC<br>PDY3A                              | I<br>I<br>I<br>I           | RO<br>RO<br>RO<br>RO<br>RO<br>RO                                                                 |
| ROR      |                        | 1 | Deriv Of density mrt alt. |               | /GENF /(  | 313)    | BL7<br>BL8<br>EQUA3<br>POBC<br>PDY3A                                              | 1<br>1<br>1                | ROR<br>ROR<br>ROR<br>ROR<br>ROR                                                                  |
| SIDAE    | sin(α-ε <sub>É</sub> ) | I | See symbol                |               | /GENF /(  | 557)    | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>VT                                    | I<br>I<br>I<br>I<br>I      | SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE                                      |
| SINA     | şîn∝                   | I | See symbol                |               | /AECO3 /( | 7)      | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>GUI3A<br>OUT<br>VT                    | I<br>I<br>I<br>I<br>M<br>I | SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA                                     |
| SINGAM   | \$1 <b>n(</b>          | I | See symbol                |               | /STATE3/( | 688)    | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODEL4<br>MODEL4<br>POBC<br>POY3A<br>SDER3 | ΑI                         | SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM           |
| SINPSI   | sîn(∳)                 | I | See sy¤bol                |               | /STATE3/( | 764)    | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODEL6<br>MODEL6<br>POBC<br>PDY3A          |                            | SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI           |
| S I NRHÐ | sιn(ρ)                 | 1 | See symbol                |               | /STATE3/( | 706)    | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODEL6<br>MODEL6<br>OUT<br>POBC<br>POY3A   | I<br>I<br>I                | SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO |
| SIN2RO   | s i π ( 2 ρ )          | М | See symbol                |               | /STATE3/( | 755)    | BL4<br>BL7<br>BL8<br>MODELA<br>MODELA                                             |                            | SIN2RO<br>SIN2RO<br>SIN2RO<br>SIN2RO<br>SIN2RO                                                   |

| FORTRAN | MATH   | CODE DESC                                                            | RIPTION                                           | STORAGE   | SUMPOUTINE USAGE                                                                                                                                                                                                                                                                                                         |
|---------|--------|----------------------------------------------------------------------|---------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL | DE 30                                                                | HILL I TOK                                        | BLOCK L   | ÖC SUBA CODE VAR                                                                                                                                                                                                                                                                                                         |
| Т       | Ţ      | I Thrust                                                             | (LBS)                                             | /GENF /-( | 411) ACCEL I T BLGCON M T BL4 I T BL4 I T BL6 I T BL8 I' T EL2 I T EQUAS O T FH1 I T FH2 I T FH3 I T FH4 I T IMPUL I T PROPEN O T REUS O T SOERS I T                                                                                                                                                                     |
| V       | ٧      | I Relative velocity                                                  | (FT/SEC)                                          | /STATE3/C | 1) ACCEL I V ADICB3 O VAR ADICB3 O VAR ADICB3 O VAR AGETB3 O VAR AST3 I VAR BL4 I V BL7 I V BL8 I V CON3 I VAR DER3A I V DTF3 I V MODELA I VAR MODELB I V MODELB I V MTX3A I VAR OUT I V OUT I VAR PDBC I V PDY3A I V REU3 M VAR RCTA3A M V STP3 I VAR TOPM D KUOW YREF3 M V |
| XK3     |        | O Third control vector go<br>Corresponds to error in<br>involving α. | everning equation value.<br>In algebraic equation | /GENF /(  | 574) BL2 0 XK3 BL3 0 XK3 BL4 0 XK3 BL5 0 XK3 BL6 0 XK3 BL6 0 XK3 BL6 0 XK3 BL8 0 XK3 MODELA I XK3 OUT I XK3                                                                                                                                                                                                              |
| XK3A    |        | O Partial of governing eq<br>vector component                        | uation mrt state or control                       | /GENF /(  | 583) BLGCON I XK3A<br>BL2 O XK3A<br>BL3 O XK3A<br>BL4 O XK3A<br>BL5 M XK3A<br>BL6 O XK3A<br>BL7 O XK3A<br>BL8 O XK3A                                                                                                                                                                                                     |
| XK3D    |        | 9 Partial of governing ec<br>vector component                        | quation mrt state or control                      | /GENF /(  | 580) BLGCON I XX3D<br>BL4 0 XX3D<br>BL6 0 XX3D<br>BL7 0 XX3D<br>BL8 0 XX3D                                                                                                                                                                                                                                               |
| XK3G    |        | O Partial of governing equector component                            | quation wrt state or control                      | /GENF /(  | 589) BL4 D XK3G<br>BL7 D XK3G<br>BL8 D XK3G                                                                                                                                                                                                                                                                              |

| FORTRAN | MATH   | CODE  | DECEDIATION                                                         | S T   | ORA' |      | SUARDJ                                 | TINE        | US 4 3E                                      |
|---------|--------|-------|---------------------------------------------------------------------|-------|------|------|----------------------------------------|-------------|----------------------------------------------|
| SYMBOL  | SYMBOL | .,,,, | DESCRIPTION                                                         | BLOCK |      | LOC  | Sign                                   | CODE        | VAR                                          |
| XK3M    | ,      | 0     | Partial of governing equation art state or control vector component | /GENF | /(   | 604) | BL4<br>BL5<br>BL6<br>BL7<br>BL8        | m<br>0<br>0 | XK3M<br>XK3M<br>XK3M<br>XK3M<br>XK3M<br>XK3M |
| XK30    |        | 0     | Partial of governing equation wrt state or control vector component | /GENF | /(   | 598) | BL4<br>BL7<br>BL8                      | õ           | XK30<br>XK30<br>XK30                         |
| XK3P    |        | 0     | Partial of governing equation wrt state or control vector component | /GENF | /(   | 592) | BL4<br>BL7<br>BL8                      | ō           | XK3P<br>XK3P<br>XK3P                         |
| XK3R    |        | ð     | Partial of governing equation prt state or control vector component | /GENF | /(   | 595) | BL3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8 | 0<br>0<br>0 | XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R<br>XK3R |
| XK3T    |        | 0     | Partial of governing equation wrt state or control vector component | /GENF | K    | 517) | BLGCON<br>BL4<br>BL6<br>BL7<br>BL8     | 0           | XK3T<br>XK3T<br>XK3T<br>XK3T<br>XK3T         |
| XK3V    |        | 0     | Partial of governing equation art state or control vector component | /GENF | /(   | 586) | 8L3<br>BL4<br>BL5<br>BL6<br>BL7<br>BL8 | 0<br>M<br>0 | XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A<br>XK3A |

```
SUBROUTINE BLB
COMMON/GENF/
1234567890123456789012345678
   BLAFFER SENSE GENERAL SENSE GE
   ,TOL(9)
,COTI(9,9)
,DPSQ
,PA
,CSR
,TOP
,DIP(20)
,DIS1(20)
,TAX
,FPD
,LIFTY
,DB
   , WDC(20)
DTP
.05
.C5
.SUMSQ
.TR(9)
.W
.BMP
.TBU(20)
,MACHY
   NF/
, OMGP(20,2), VARD(9),
, ACON(9) , &CON(9),
, OT , 6
, RE , MACH
, PAR , ROR
, TIMEPH , TIMES
, TPH (20), DIS(20)
, TLS1 (20), DIP1(20)
   *046(20)
*A(9,9)
*DT5
   ,SVAR(10)
,DCON(9)
   RO
   ×À
   , VNR
TOS
   TIME
  ,LIFTA
,EP
,QV
,LIFTA
LIFTA
   *TIMPR
*AE
*QR
*LIFTR
  DRAG
FPGLD
FVAC
   TBURN
   DRAGA
ISPF
ULFTA
CODAE
SID
   DRAGR
  GENF
  DBR
ULFT
XMCGR
CALPHA
XCG
  DHAGV
DB
ULFTV
XMCGA
CDE
ZCG
   , ULFTR
, ULFTR
, XMCSM
, DELTAE
, XJ
   GENF
GENF
GENF
GENF
GENF
GENF
  , XMCGV
, CT
, SIDAE
GÉNF /
, XJR
, IRATEB
   *XMC6
*CULFT
   , XKG
   , XKP
  , 1K3
, 1K3D
, 1K3P
, 1K3D
, 1K3D
, 1K3D
, 1K3M
, DPDY(3,8)
  GENF
   , XK2
, XK2D
, XK2V
, XK2P
, XK2P
, XK2M
, PO
   GENF
GENF
GENF
GENF
  GENF
GENF
GENF
FRAT
  MACH,
  FRAI
GENF
SENF
STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
  ,SVY(10)
,SAVBP(15)
,8CORO2
   DVARL(99) , YO(9)
   ,SINGAM
   ,00V
,006
,008
,VDP
,600
   STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
   PDV
PDG
PDR
PDM
 VOA
  REAL MDM MDV, MDR
CDMMON/STÂTE3/
SINZRO CCOSZRO
EQUIVALENCE (VAR(1), V) (VAR(2), GAM) (VAR(3), ALT) (VAR(4), M)
E(VAR(5), PS1), VAR(6), HAD), (VAR(7), MU), (VAR(8), NT) (VAR(9), SQ2)
E(DVAR(1), VD), (DVAR(2), SD), (DVAR(3), HD), (DVAR(4), MD), (BVAR(5), PD),
E(DVAR(6), DD), (DVAR(7), UD), (DVAR(8), HTD), (DVAR(9), SQ2D)
REAL M, MU, MD
COMMON/AECO3/
*APHO APHR ALPHA VDA GDA PDA
*SINA COSA PHIO PHID PHI
*SINA COSA PHIO PHID PHI
*SINA COSA PHIO PHID PHI
*CDSPHI GDPH PDPH XLAMA(9) XLAMP(9) CDO
*CDOM CLO FK
*CDM CLO FK
*CDM CHA CMA CMM CMD CMO CMOM FKM
*CLAM CL CLA CCM
*CD CDA CDA
*CDM COMMON /SPÉCD/ UMUZ, RÔRR
ENTRY BL8010
ASSIGN 30 TO IGO
GO TO 601
ENTRY BL8001
ASSIGN 50 TO IGO
GO TO 601
ENTRY BL8000
ASSIGN 50 TO IGO
GO TO 601
ENTRY BL8000
ASSIGN 50 TO IGO
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ASSIGN 50 TO IGO
GO TO 601
ENTRY BL8000
ASSIGN 60 TO IGO
  STATES
   EQUIV33
EQUIV33
EQUIV33
EQUIV33
AECCO33
AECCO33
AECCO33
AECCO33
AECCO3
BL8
BL8
 601.
6123.
653.
657.
670.
712.
  BL8
  8L8
8L8
8L8
   601
  BLB
BLB
BLB
BLB
   601-
  BLB
   = V+ 51NGAM
= ROR/6.3
= RORR/6.3
73
74.
75.
  BLB
BLB
BLB
   601 ROOT
  R6R
R6AR
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20 OCT TZ 6 01-46

### SUBRØUT I NE BNTG

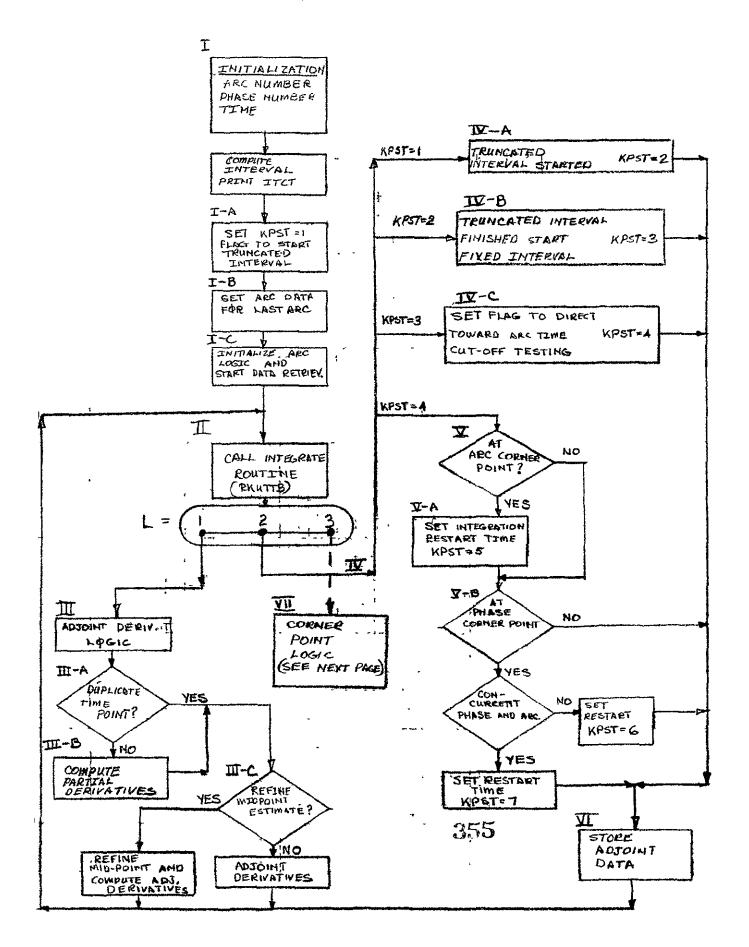
#### BNTG

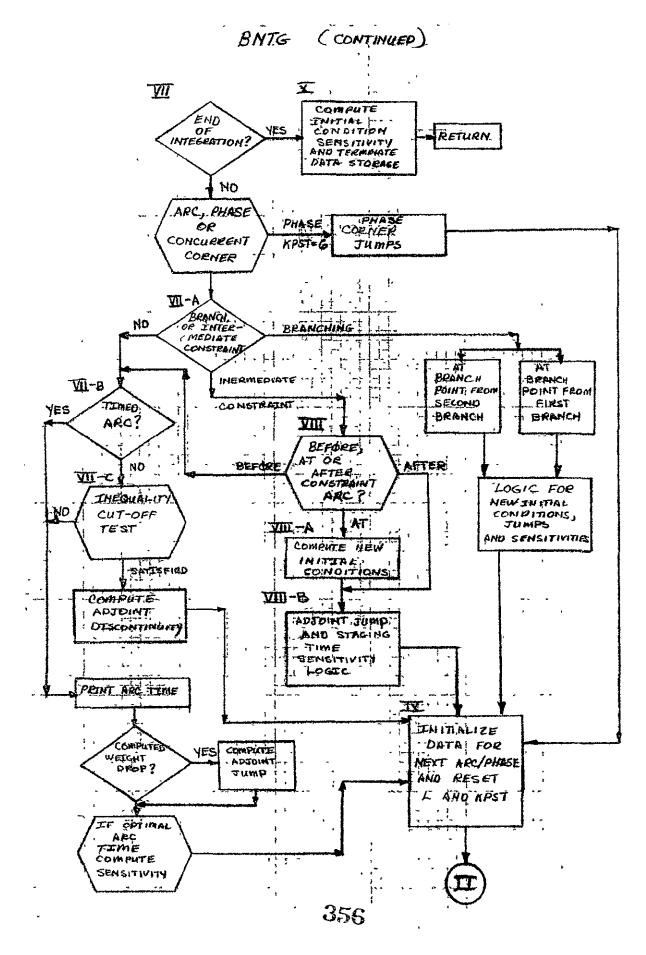
#### Purpose

BNTG is an executive routine that controls integration of adjoint system. On the CDC computer overlay software, it is a program that heads up an overlay, whereas on the UNIVAC system it is a subroutine.

#### Description

The key aspect of the backward adjoint integration logic is that the compute intervals are precisely matched to the previous nominal forward trajectory compute intervals. The integration is started at the end of each arc using a saved truncated time interval (the same truncated interval required to satisfy the arc cut-off on the nominal trajectory). After completing the interval, the integration is restarted with the full step size and continues until the beginning of the arc. This process continues until the beginning of the first arc where the logic recognizes (VII) that initial time has been reached and proceeds to terminate storage of adjoint data (X).





| FORTRAN<br>SYMBOL | MATH<br>Symbol   | CODE | DESCRIPTION                                                 |       | BLOLA    | DRAG | E<br>LOC | <u> </u>                                                                                                                |                            | E VAR                                                                                                                                                      |
|-------------------|------------------|------|-------------------------------------------------------------|-------|----------|------|----------|-------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A                 | A                | I    | Control integral matrix                                     |       | / GENF   | /(   | 109)     | ADECISA<br>ADICES<br>BGETS<br>BNTG<br>BSTOS<br>BSTOS<br>MTXSA<br>PAYO2<br>SDINP<br>TRANS                                |                            | A A A A A A A A A A A A A A                                                                                                                                |
| ARCDA             | S <sub>ref</sub> | I    | Aerodynamic reference area (FT                              | -2,   | / AR CDA | τ/(  | 1)       | BNTG<br>EQUAS<br>FNTG<br>FXDAT<br>FXDAT<br>FXDAT<br>GEINP<br>SBINP<br>SIZIN<br>SIZIN<br>VT                              | 1<br>1<br>1<br>0<br>M<br>1 | AREFA ARCDA ARCDA ARCDA ARCDA ARCDA ARCEF SREF                                                                                                             |
| DIP               |                  | 1    | Array of phase end integration intervals for tria           | ı l   | /GENF    | /(   | 391)     | BNT G<br>FNT G                                                                                                          | 1<br>G                     | DIP<br>DIP                                                                                                                                                 |
| DIS               |                  | I    | Array of arc end integration intervals for trial trajectory |       | / GENF   | 70   | 371)     | BNTG<br>FNTG                                                                                                            | I<br>O                     | DIS                                                                                                                                                        |
| DT                |                  | M    | Integration interval (SE                                    | (C) . | / GENF   | 70   | 300)     | BNTG<br>FNTG<br>REU3<br>RKTA3A<br>RKTB3A<br>STP3<br>YREF3                                                               |                            | DT<br>DT<br>P<br>P<br>DT<br>DT                                                                                                                             |
| DTNC              | Δτ               | I    | Integration interval (SE                                    | (C)   | / AR CDA | T/C  | 5)       | BNTG<br>FNTG<br>GEINP<br>PROPIN                                                                                         | I<br>M<br>I                | DINC<br>DINC<br>DINC<br>DINC                                                                                                                               |
| IARC              |                  | M    | Arc number                                                  |       | /XCODE:  | S/(  | 146)     | ADICB3<br>ADID3A<br>ADID3T<br>AST3<br>AST3<br>ENVPRM<br>FNTGTELB<br>PROPB<br>PROPB<br>PROPI<br>STAD3<br>STAD3<br>TRTOSZ | IIIMIMIIIIAII              | I ARCCCIARCCCIARCCCIARCCCIARCCCIARCCCIARCCCIARCCCIARCCCIARCCCIARCCCIARCCCIARCCCIARCCIARCCIARCCIARCCIARCCIARCCIARCCIARCCIARCCIARCCIARCCIARCCIARCCIARCCIARCC |
| INTB              |                  | I    | Branching and intermediate constraint flag                  |       | /XCODE:  | 5/(  | 31)      | ADIC3A<br>BNTG<br>ENVPRM<br>FNTG<br>SDINP<br>TEST<br>TRAN3<br>TRTOSZ                                                    | 1<br>1<br>1<br>1<br>1      | INTB                                                                                                                                                       |
| IPH               |                  | m    | Phase number                                                |       | /XCOBE   | 5/(  | 143)     | ADID3A<br>ADJUST<br>AST3<br>BNTG<br>FNTG<br>GETIT<br>GUI3A<br>SDINP                                                     | I                          | 1 P H<br>1 P H<br>1 P H<br>1 P H<br>1 P H<br>1 P H<br>1 P H                                                                                                |
| IPP               |                  | М    | Phase number at last derivative evaluation                  |       | /BNTG    | /(+  | )        | BNTG                                                                                                                    | W                          | IPP                                                                                                                                                        |

| FORTRAN<br>SYMBOL | MAIH<br>Symbol | CODE                      | DESCRIPTION                                                                                     | SIORAG<br>Block        | F F F F F F F F F F F F F F F F F F F | <u> </u>                                                                      |                       | E USAGE<br>E VAR                                             |
|-------------------|----------------|---------------------------|-------------------------------------------------------------------------------------------------|------------------------|---------------------------------------|-------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------|
| 1101              |                | I Iteration co            | punter                                                                                          | /xcodes/(              | 148)                                  | BNTG<br>OUT<br>TEST<br>TOPM                                                   | I<br>I<br>M           | ITCT<br>ITCT<br>ITCT<br>ITCT                                 |
| JGIO              |                |                           | ot last derivative evaluation<br>on flag array                                                  | /BNTG /(*<br>/xcodes/( |                                       | BNTG<br>BNTG<br>FNTG                                                          | W<br>I<br>I           | ITT<br>JGID<br>JGID                                          |
| ligi              |                | O Control opt!            | D P                                                                                             | /XCODES/(              | 195)                                  | SDINP ACCEL BNTG DERSA FOTG GUISA MODELA MODELB MTXSA PDYSA                   |                       | 7611<br>7611<br>7611<br>7611<br>7611<br>7611<br>7611<br>7611 |
| 3K                |                |                           | routine flag tells which derivative<br>n Runge-Kutta cycle                                      | /XCODES/(              | 151)                                  | ADIC3A<br>BNTG<br>MODELA<br>PAYO2<br>RKTA3A<br>RKTB3A                         | I<br>M<br>M           | JK<br>JK<br>JK<br>J                                          |
| HAL               |                | I Phase cut-of            | foption flag                                                                                    | /XCODE\$/(             | 72)                                   | BNTG<br>FNTG<br>SDINP                                                         | I<br>M                | JPH<br>JPH<br>JPH                                            |
| JES               |                | M Absolute val            | ue of phase cut-off option code                                                                 | /XCODES/C              | 152)                                  | ADID3A<br>BNTG<br>FNTG<br>STP3<br>TOL3                                        | I<br>M<br>M<br>I<br>I | JPS<br>JPS<br>JPS<br>JPS<br>JPS                              |
| 12                |                | m, Absolute val           | ue of arc cut-off option code                                                                   | /xcodes/(              | 153)                                  | ADICB3<br>ADIC3A<br>ADID3A<br>BNTG<br>FNTG<br>PROPB<br>PROPIN<br>STP3<br>TOL3 | I<br>I<br>M<br>M      | 12<br>12<br>12<br>13<br>12<br>12<br>12<br>12<br>12<br>12     |
| TZL               |                | I Arc cut-off             | option flag                                                                                     | /XCODE5/(              | 112)                                  | ADICB3<br>BNTG<br>FNTG<br>SDINP                                               | I<br>I<br>I           | JST<br>JST<br>JST<br>JST                                     |
| KPST              |                | M Controls log            | ic for compute interval during adjoint                                                          | /xcodes/(              | 155)                                  | BNTG<br>FNT G                                                                 | M                     | KPST<br>KPST                                                 |
| L                 |                | L = 1 z<br>= 2 c          | traffic control flag<br>leans evaluate derivatives<br>check cut-off<br>rint or cut-off detected | /xcodes/(              | 177)                                  | BNTG<br>FNTG<br>OUT<br>RKTA3A<br>RKTB3A<br>SDINP                              |                       | L<br>L<br>L<br>L                                             |
| NB                |                | 0 Extent of in<br>problem | tegration set during adjoints on branch                                                         | /XCOBES/(              | 179)                                  | ADEQ3A<br>ADICB3<br>ADIC3A<br>BNTG<br>RKT83A<br>STVRL3                        | M<br>0<br>1           | NB<br>NB<br>NB<br>NB<br>NB                                   |

| ORIRAN  | MATH   | CODE DESCRIPTION                                                                    | STORAGE           | SUBROUTINE USAGE                                                                                                                                                                    |
|---------|--------|-------------------------------------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL | DE 2CUIFIIUM                                                                        | BLOUK LOC         | SUBA CODE VAR                                                                                                                                                                       |
| NCN     |        | I Number of elements in d∛                                                          | /xCode\$/( 160)   | ADEQ3A I NCN ADIC83 I NCN ADIC3A I NCN ADIC3A I NCN ADIUST I NCN AST3 M NCN BNTG I NCN BST03 I NCN MTX3A I NCN MTX3A I NCN PAY02 M NCN TEST M NCN TEST M NCN TOPM I NCN TRAN3 I NCN |
| NICNB   |        | I Number of constraints at intermediate constrai<br>point or at end of first branch | nt /XCDDES/( 135) | ADICB3 I NICNB ADIC3A I NICNB BNTG I NICNB REU3 I NICNB SDINP M NICNB TEST I NICNB TRAN3 I NICNB                                                                                    |
| NP AR A |        | I Number of adjustable parameters in trajectory problem.                            | /PARAM /( 13)     | DADJUST I NPARA BNTG I NPARA FNTG I NPARA MTX3A I NPARA PAYO2 I NPARA PRMSET I NPARA SDINP M NPARA STAU I NPARA TEST I NPARA TOPM D NPARA                                           |
| NPH     |        | I Nu≋ber of phases in trajectory                                                    | /XC@BES/( 164)    | BNTG I NPH FNTG O NPH PRMSET I NPH SDINP M NPH TEST I NPH TOPM I NPH                                                                                                                |
| NSAB    |        | I Number of arcs on first branch                                                    | /xCanes/( 134     | DADICB3 I NSAB<br>BNTG I NSAB<br>ENVPRM I NSAB<br>FNTG I NSAB<br>SOINP M NSAB<br>TEST I NSAB<br>TRAN3 I NSAB<br>TRTOSZ I NSAB                                                       |
| NSB     |        | I Number of arcs prior to branch point or<br>intermediate constraint                | /XC00ES/( 133)    | DADICB3 I NSB<br>BNTG I NSB<br>ENVPRM I NSB<br>FNTG I NSB<br>REU3 I NSB<br>SDINP M NSB<br>TEST I NSB<br>TRAN3 I NSB<br>TRTOSZ I NSB                                                 |
| NST     |        | I Number of arcs in trajectory                                                      | /xCedES/( 166     | D BNTG I NST<br>FNTG O NST<br>PROPB I NST<br>SDINP I NS<br>SDINP M NST<br>TEST I NST<br>TOPM I NST<br>TRANS I NST                                                                   |

| FORTRAN     | HTAM               | CODE DESCRIPTION                                   | STORAGE        | SUBROUTINE USAGE                                                                                                                                                                                  |
|-------------|--------------------|----------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL      | 5YM80L             | CODE DESCRIPTION                                   | RFORK FO       | SUBRIQUE VAR                                                                                                                                                                                      |
| SVAR        | y   <sub>t=0</sub> | l Array of state values at initial problem time (s | d] /GENF /( 7  | 9) ADJUST O SVAR 8NIG I SVAR FNIG I SVAR PRMSET M SVAR REU3 I SVAR SDINP M SVAR TEST I SVAR TOPM I SVAR TRIOSZ I SVAR                                                                             |
| TIME        | t                  | M. Tree (elapsed)                                  | /GENF /( 49    | 3) ADICB3 O TIME AST3 I TIME BNTG M TIME CON3 I TIME CON3 I TIME ENVPRM I TIME EQUAS I TIME FNTG M TIME MODELA I TIME OUT I TIME PROPIN I TIME PROPIN I TIME REUS M TIME RKTASA M TT YREFS M TIME |
| TIMPR       |                    | O Trajectory print time                            | /GENF /( 49    | 5) BNTG O TIMPR<br>FNTG M TIMPR<br>GKTA3A I TP<br>RKTB3A I TP                                                                                                                                     |
| TOP         |                    | M Elasped time at phase initiation                 | /GENF /( 32    | O) BNTG M TOP<br>EQUAS I TOP<br>FNTG M TOP                                                                                                                                                        |
| TOS         |                    | M Elasped time at arc initiation                   | /GENF /( 32    | 1) BNTG M TOS<br>EQUA3 I TOS<br>FNTG M TOS                                                                                                                                                        |
| TPH1        |                    | I Phase and times for nominal trajectory           | /GENF /( 41    | 3) BNTG I TPH1 GETIT I TPH1 SDINP O TPH1 TEST O TPH1 TOPM I TPH1                                                                                                                                  |
| TST         |                    | I Array of arc end times on trial trajectory [sd]  | /GENF /( 33    | 1) ADICB3 I TST<br>BNTG I TST<br>FNTG 0 TST<br>TEST I TST                                                                                                                                         |
| <b>TST1</b> |                    | I Arc end times for nominal trajectory             | /GENF /( 43    | 3) BNTG I TST1 GETIT I TST1 PROPIN I TST1 SDINP O TST1 TEST O TST1 TOPM I TST1 TRAN3 I TST1 TRTOSZ I TST1                                                                                         |
| TSV         |                    | W Time at last derivative evaluation               | /BNTG /(+      | ) BNTG W TSV                                                                                                                                                                                      |
| MDC         |                    | I Array of drop weight per arcisdl (L              | BS) /GENF /( 8 | 9) BNTG I WDC<br>REU3 I WDC<br>SDINP M WDC                                                                                                                                                        |

```
CONTROLS INTEGRATION OF ADJOINT DIFFERENTIAL EQUATIONS
USES TRAFFIC FLAG L FOR THE RUNGE-KUTTA INTEGRATION(RKUTTB
WHERE L=1 MEANS COMPUTE DERIVATIVES
L=2 TEST STOPPING CONDITION
L=3 PRINT OR CORNER POINT
L=4 RESTART INTEGRATION

XPST IS THE ARC INITIATION AND STAGING FLAG
=1 FOR STARTING ARC AT TRUNCATED COMPUTE INERVAL
COMMON /XCDOES/
+ITQ (9),1COR (20),1T1 ,INTB
+120P ,ICOP
*10PEN ,ICOP
  BNTG
       1.
23
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67
89
10
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, NCNST
, IFAM
, ISPH
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, NEQ
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, LB
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   ,JGID(20,2),JPH (20,2),

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,IFB ,IND ,

,IARC ,ISTART ,

,JPS ,JS ,

,NAD ,NCASE ,

,NPH ,NCASE ,

,NPH ,ISTNB ,

,IPHN ,ISTNB ,

,NPHP ,NPHB ,NPHB ,NPHP ,NPHB ,NPHB
  ,INTB
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  , XLAMRF
  ,YMURF
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   , MAXTAB
   , NF AR C
  GLOBAL
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   TOL(9), COTI(9,9), COTI(9,9), PA (SR , TOP, DIP(20), DISI(20), TAX (FPD , TAX (FPD , TAX ) COTIC (FPD , TAX 
   , WDC(21
, DTP
, QS
, CS
, SUMSQ
, TR(9)
, W
   ,SVAR(10)
,DCON(9)
   MBC(20)
  , RD
   , VNR
   TIME
TIME
TBURN
MACHR
  TBU(20)
   DRAGA
ISPF
ULFTA
CODAE
SID
  , DRAGR
, ISP
, ULFTR
, XMCGM
   GENF
GENF
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GENF
  *LIFTR
  , LIFTA
LIFTM
  DBR
ULFT
XMCGR
CALPHA
  URAGV
OB
ULFTV
XMCGA
CDE
,ZCG
  ,XMCGV
,CT
,SIDAE
GENF /
,XJR
,IRATED
   *CULFT
*COD
COMMON /
*XJV
   , DELTAE
   , XCE
   , GH
  , XKP
  , GAMMAD
   , XKG
   GENF
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*XK1A
*XK1A
*XK1B
*XK1U
*PV
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, XK1D
, XK1V
, XK1P
, XK10
, XK1B
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, XK3V
, XK3P
, XK3D
, XK3M
, XK3M
   SENF
SENF
GENF
GENF
   GENF
GENF
FRAT
GENF
   ,PO
   масн,
```

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```
*PI ,RAD ,RDI ,SC ,UMF ,.....
*FTNM ,CAR ,JOP1 ,JDP2 ,JDP3 ,JDP4 COMMON/PARAM/
*IPOINT(12),NPARA,NPA ,SPARA(9,12),WTPD (9),WTP (12),
*SPARB(9,12) , PARA(12),DPAR(12) ,521NV(9,9)
*,DELP(9)
*DULYALENCE(INEQFL(20),INQF)
EQUIVALENCE(INEQFL(20),INQF)
EQUIVALENCE (INEDS,ILAB(2))
THIS PROGRAM DOES THE INTEGRATION OF THE ADJOINT SOLUTION
  , DATA
DATA
PARAM
  PARAM
  PARAM
NOS
APR27
BNIG
            CCC
  1 INITIALIZATION
IARC= NST
IPH = NPH
TIME = TST(IARC)
TOS = TST1(IARC)
TOP = TPH1(IPH)
                        TOP = TPH1(IPH)

CALCULATE COMP INTERVAL

DT =-DIS(NST)

CALL IPR(4HITCT, A, ITCT, 1, 1)

KPST =1

I - A SET FLAG TO START ARC AT TRUNCATED INTERVAL

JS=IABS(JST(NST-1))

JSII=JGID(NPH, 2)

I - B GET DATA FOR ARC

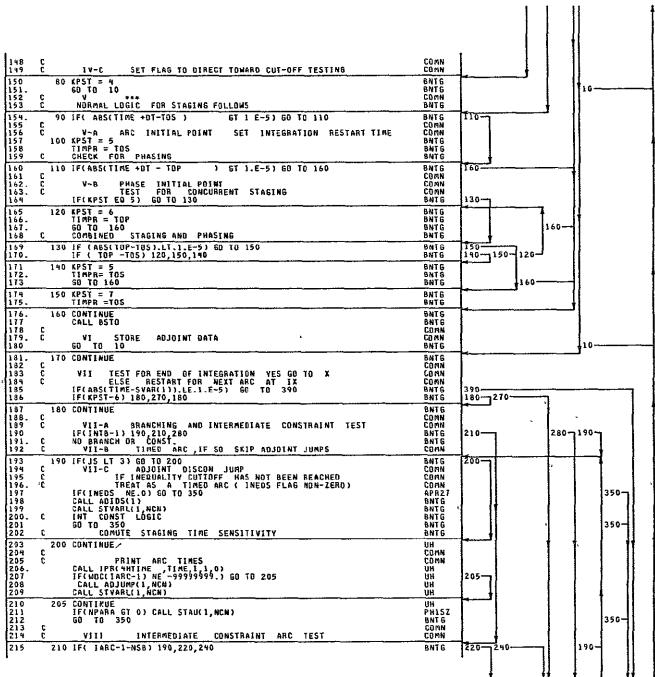
CALL READMS(9, ARCDA, 51, IARC)

JPS=IABS(JPH(NPH-1, 2))

L=4
            C
  COMN
BNTS
BNTS
COMN
            C
            C
  FRAT
BNTG
BNTG
BNTG
COAN
PO14
BNTG
BNTG
                        103
104
105.
106.
107.
108.
            C
   COMN
                             II INTEGRATION SUBROUTINE REUTTB
110
111.
112.
113.
114.
115
                  10 CALL REUTTB
60 TO (20,50,170),L
   BNTS
BNTS
COMN
COMN
  20--- 50--- 170
            00000
                    CALCULATE ADJOINT DERIVATIVES
III-A SKIP DERIV CALC AT DUPLICATE TIME POINT
EXCEPT AT STAGE CHANGE
   BNT G
COMN
COMN
   BNTG
COMN
COMN
BNTG
  30-
117
                  20 IF(TIME EQ TSV.AND ITT.EQ. LARC. AND. 1PP.EQ 1PH) GO TO 30
117
118
119.
120
121
122.
123
124.
125
            C
                         III-B PARTIAL DERIVATIVES
CALL MODEL
TSV = TIME
ITT=IAC
IPP =IPH
   BNT6
BNT6
BNTG
            CCC
  COMN
COMN
                           111-C SPECIAL ADJOINT DERIVATIVE WITH REFINED ESTIMATE OF IMPULSE RESPONSE FUNCTIONS
  COMN
                   30 IF(JK.NE.3) 50 TO 40
CALL SNSADJ
60 TO 10
  BNTG
   40
127.
   BNTG
128.
129.
130.
131
132
  BNTG
                   40 CALL ADER
   COMN
COMN
BNT G
            C
                         111-0
60 TO 10
  ADJOINT DERIVATIVES AND A MATRIX INTEGRANDS
  10-
133
134.
135.
136
137
138.
   BAT G
COMN
COMN
                   50 CONTINUE
            0
                         TEST FOR STAGING CONDITIONS
GO TO (60,70,80,90,160,160,160),KPST
  BATE
  BNTG
  <u>•0</u>—70 → 80 → 90.
   160
                   60 KPST =2

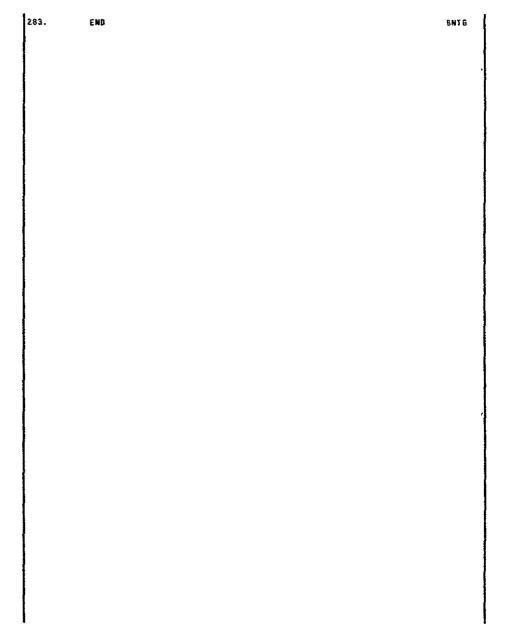
1V-A TRUNCATED INTERVAL HAS STARTED

60 TO 160
 139.
140
141.
142
143.
  BNTG
            Ç
  COMN
  BNT 6
COMM
   160-
                            IV-B
  TRUNCATED INTERVAL FINISHED START FIXED INTERVAL
  COMN
 144.
145.
146.
147.
                   70 KPST =3
L=4
DT =-DTHC
SO TO 160
  BNTG
  BNTG
BNTG
BNTG
  160
```



|                                                                                                   | 1 11 1 1 11        |
|---------------------------------------------------------------------------------------------------|--------------------|
|                                                                                                   |                    |
|                                                                                                   |                    |
| 712 6                                                                                             | CORN               |
| 216 C<br>217 C VIII-A INTRODUCE AND INITIALIZE NEW ADJOINT                                        |                    |
| 18 220 FALL ADICB<br>19. C VIII-B ADJOINT JUMP + STAGING TIME SENSIT                              | IVITY LOGIC COMM   |
| 20 C FOR BOT4 INT. COMST. AND BRANCH TRUNK<br>21. IF(JS.LT.3) 60 TO 230                           | COMN<br>BNTG 230-  |
| 22 CALL ADIDS(MICHB1)<br>23. CALL STVARL(1,NCN)                                                   | BNTS BNTS          |
| 24 GD TO 350                                                                                      | BNTG 350-          |
| 25 230 CALL STYARL(1,NCN)<br>26 IF(NPARA.GT.O) CALL STAU( 1,NCM)                                  | BNTG A             |
| 27 60 10 350                                                                                      | BNTG 35G-          |
| 28                                                                                                | BNTG 260-          |
| 30 250 CALL STVARL(NICNB+1,NCM)<br>31 GB TO 350                                                   | BNTG 350-          |
| 32 260 CALL STVARL(NICHB+1,NCM)                                                                   | BATG               |
| 34 60 10 350                                                                                      | BNTG 350-          |
| 35 270 IF(JPS.LT 3) 60 TD 360<br>36 CALL ADIDP( 1)<br>37 CALL STVARL(1,NCH)                       | BNIG<br>BNIG       |
| 37 CALL STVARL(1,NCM)<br>38. SO TO 360                                                            | BNTG 360-          |
| 39 280 IF( 1ARC-1-(NSAB+NSB))300,290,240                                                          | BNTG 290-300-240-  |
| 240 C AT BRANCHING POINT FROM SÉGMENT III 241 290 CALL ADI3B                                      | BNTG               |
| 242. CALL STVARL(I,NICNB)                                                                         | BNTG               |
| 143 60 TO 350<br>144 300 If(IARC-1-NSB) 190,310,320                                               | BNTG 310-320- 190- |
| 245 C AT BRANCHING PT FROM SEGMENT II                                                             | BNTG               |
| 246. 310 NB =1<br>247 C RESTORE BRANCH ELEMENT IN A MATRIX                                        | BNTG               |
| 248. CALL ADIZB<br>249. GB TO 190                                                                 | BNT G<br>BNT G     |
| 250 C IN SEGMENT II<br>251 320 IF(JS.LT.3) 60 TO 340                                              | BNT6 340-          |
| S2 CALL ADIDSS(NICNB)                                                                             | BNTS               |
| 153. 330 CALL STVARL(1,NICNB)<br>154 GO TO 350                                                    | BNTG 350           |
| 55 340 CALL STVARL(1, NICNB)<br>56 IF(NPARA GT O) CALL STAU(1, NICNB)                             | BNTG<br>BNTS       |
| 256 IF(NPARA BY O) CALL STAU(1,NICMB)<br>257 C<br>158 C IX INITIALIZE DATA FOR NEXT ARC AND RESET | COMN               |
| 59 350 IARC=IARC-1                                                                                | BNTG               |
| 260 C CALCULATE DT<br>261 BT =-DIS(IARC)                                                          | BNTG               |
| 62. CALL READMS(9,ARCDA,51,IARC)<br>63. JS=IABS(JST(IARC-1))                                      | FRAT<br>- APR27    |
| 64 CALL PROPB<br>265 TOS=TST1(IARC)                                                               | BNTG               |
| .66                                                                                               | BNTG 370-380-360   |
| 268 360 DT =-DIP(IPH-1)                                                                           | BNIG               |
| 269_ 370 IPH =1PH-1                                                                               | BNTG               |
| 70                                                                                                | BNTG               |
| 72 TOP=TPH1(1PH)                                                                                  | BNTG               |
| 275. TIMPR = -1.E6                                                                                | BNTG<br>BNTG       |
| 276 L=4                                                                                           | BNTG               |
| 277 G0 T0 10<br>278 390 CONTINUE                                                                  | BNTG               |
| 279. C X COMPUTE IC SENSITIVITY AND TERMINATE DE                                                  | COMN }             |
| 201. IF(NPARA.GT.O) CALL SINIT(I, NCN) 282 CALL ENDS                                              | BNTG               |
| OL DALL ENVO                                                                                      | onio į             |

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# SUBRØUT I NE BSTØ3

#### Subroutine BST03

### Purpose

BST03 handles the storage of the adjoint data first in a dynamic buffer, Z, and when this buffer is filled, it dumps the buffer onto random storage file 41.

This subroutine also has an entry point SNSADJ which refines the impulse response function,  $\Lambda^{\Psi_i\;\Omega_j}$ , estimate at mid-integration interval before storing.

### Description

The order of storage of information at each adjoint-solution time point in the Z buffer is listed below.

- 1. The adjoint variable  $\lambda^{\Psi_1\Omega_j}$  matrix is stored. Each column in this matrix corresponds to a different constraint,  $\Psi_1$ ; each row corresponds to an element in the state vector.
- 2. The impulse response function vectors are stored. These vectors, XLAMA and XLAMP contain an element for each element in the  $d\Psi_1$  vector.
- 3. The upper triangular portion of the A matrix is stored.—Only this part is needed since A is a symmetric matrix.

| FORTHAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                                                                              | S T O R A I | LOC  | <u> 5 UAROUT</u><br>5 UBR (                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                 | AGE                                    |
|-------------------|----------------|------|----------------------------------------------------------------------------------------------------------|-------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------|
| A                 | A              | 1    | Control Integral matrix                                                                                  | /GENF /(    | 109} | ADEQ3A<br>ADICB3<br>BOTG<br>BST03<br>MTX3A<br>PAY02<br>SDINP<br>TRAN3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0 A A D A D A D I A A I A I A I A                                                               |                                        |
| I B L K 1         |                | M    | Storage retrieval buffer counter                                                                         | /XCODES/(   | 173) | AST3<br>BST03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | M IBL                                                                                           |                                        |
| IBUFB             |                | M;   | Counts number of buffers of adjoint data that have either been stored or retrieved as solution progress. | /RETREV/(   | 20)  | BGET3<br>BST03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | M IBU<br>M IBU                                                                                  |                                        |
| IFB               |                | 1    | File where adjoint solution is stored                                                                    | /XCODES/(   | 140) | BGET3<br>BST03<br>TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | I IFB<br>I IFB<br>O IFB                                                                         | 3                                      |
| MAXB              |                | M    | Number of pords in last stored partial buffer of adjoint data — Corresponds to random file 41.           | /RETREV/(   | 5)   | BGET3<br>BST03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | XAM I                                                                                           |                                        |
| MIXB              |                | I    | Maximum number of words in adjoint data buffer = 3000.                                                   | /RETREV/(   | 13)  | BGET3<br>BST03<br>SDINP<br>TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | I MIX<br>I MIX<br>I MIX<br>D MIX                                                                | (B<br>(B                               |
| MXB               |                | I    | Index of last stored word in full buffer of adjoint data.                                                | /RETREV/(   | 15)  | BGET3<br>BST03<br>SDINP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1 MXB<br>I MXB<br>O MXB                                                                         | 3                                      |
| NBFB              |                | 1    | Maximum number of buffers permitted to store adjoint solution data = 60.                                 | /RETREV/(   | 11)  | BST03<br>Topm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | I NBF<br>D NBF                                                                                  |                                        |
| NBUFB             |                | 0    | Number of buffers of adjoint data stored on last adjoint solution.                                       | /RETREV/(   | 19)  | BGET3<br>BST03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | I NBU                                                                                           |                                        |
| NCN               |                | I    | Number of elements in d¥                                                                                 | /XCODES/(   | 160) | ADECSA<br>ADICBS<br>ADICSA<br>ADIDSA<br>ADSTS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BNTGS<br>BN | I NCN M NCN M NCN M NCN I NCN |                                        |
| NCNST             | n              | I    | Number of proble≃ constraints                                                                            | /XCQDES/(   | 132) | BGET3<br>BST03<br>CON3<br>PAYO2<br>SDINP<br>SUMS<br>TEST<br>TOPM<br>TRAN3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | I NCN I NCN I NCN I NCN M NCN M NCN I NCN I NCN I NCN I NCN I NCN                               | 151<br>157<br>157<br>157<br>157<br>151 |

| FORTRAN | MATH                                     | CODE DESCRIP                                                 | DESCRIPTION           | STORAGE    |            | SUBBOUTINE USA                                                                                                                                          |                                                                |  |
|---------|------------------------------------------|--------------------------------------------------------------|-----------------------|------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|--|
| SYMBOL  | SAWBOF                                   | DESCRIP                                                      | IIUN                  | BLOCK      | LOC        | SUBA COO                                                                                                                                                | E VAR                                                          |  |
| NEQ     |                                          | I Number of integrated states                                | •                     | /XCODES/(  | 162)       | ADICB3 I<br>ADIC3A I<br>ADIC3A I<br>ADIC3A I<br>AGET3 I<br>BGET3 I<br>MTX3A I<br>OUT I<br>REU3 I<br>SDER3 I<br>SDER3 I<br>SDER3 I<br>SDER3 I<br>SDER3 I | 00000000000000000000000000000000000000                         |  |
| XL      | $\gamma_{m{_4}'m{_U}}$ 1                 | I Matrix of adjoint variables                                |                       | /STATE3/(  | 246)       | ADEQ3A M<br>ADICB3 M<br>ADIC3A M<br>ADID3A M<br>AST3 M<br>BGET3 O<br>BSTO3 I<br>OUT I<br>STAU M<br>STYRL3 M                                             | XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL |  |
| XLAA    |                                          | W Temporary storage used for es<br>impulse response function | timate of midpoint    | /BST03 /(  | <b>,</b> ) | BSTO3 W                                                                                                                                                 | XLAA                                                           |  |
| XLAMA   | $\Lambda^{\hat{\Psi}_1\Omega_{\hat{J}}}$ | M Impulse response function col<br>with angle of attack      | umn vector associated | /AEC03 /(  | 16)        | ADEQ3A M<br>ADIC3A O<br>AST3 O<br>BGET3 O<br>BSTO3 M<br>MTX3A I<br>TRAN3 M                                                                              | XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA    |  |
| XLAMP   | $V_{ar{f A}^{\dagger}m{\Omega}}$ 1       | M Impulse response function col<br>with bank angle           | ums vector associated | /AEC03 /(  | 25)        | ADEO3A M<br>ADIC3A O<br>AST3 D<br>BGET3 D<br>BST03 M<br>MTX3A I<br>TRAN3 M                                                                              | XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP    |  |
| XLAP    |                                          | W Temporary storage used for es<br>impulse response function | timate of midpoint    | /BST03 /(  | <b>*</b> ) | BST03 W                                                                                                                                                 | XLAP                                                           |  |
| Z,      |                                          | W Adjoint storage buffer                                     |                       | /BST03 /(4 | <b>*</b> ) | 85T03 ₩                                                                                                                                                 | Z                                                              |  |

| C |                                  |                                            |                          | H TIME POIN        | '                 |                         | 000<br>000        |
|---|----------------------------------|--------------------------------------------|--------------------------|--------------------|-------------------|-------------------------|-------------------|
|   | DIMENSIC<br>COMMON/S<br>COMMON/S | )N XLAA(9),<br>RETREV/ FT[M<br>RETREV/     | XLAP(9)<br>E,BTIME,MAX   | (2),MAXB           |                   |                         | BST<br>RET<br>RET |
|   | *NBUFA(2)                        | IRHEL                                      | , IBUF2                  | , NBFA             | , NBFB            | , MIXA                  | , RET             |
|   | +MixB                            | - PLIA                                     | MXB                      | NPTA               | , NPTB            | IBLKB                   | RET               |
|   | * NBUFB<br>COMMON/S              | TATES/                                     |                          |                    |                   |                         | STA               |
|   | *VAH(14)                         | ,DVAR (1                                   | 4), VARL (99)            | DVARL(99)          | ,40(9)            | ,544(10)                | , STA             |
| • | *XL(9,9)<br>*SINPSI              | _YDF(20 9                                  | ),YD5 (20,9)             | ),COSGAR           | .SINGAR           | SAYBELLOI               | , STA             |
| • | +SVRV (                          | COSPSI'                                    | ,51 NRHO<br>,0MEGA2      | COSRHO             | ,осояно           | ,000002                 | , STA             |
|   | * 40 4                           | CDV                                        | RITU                     | HDV                | ,PDV              | 004                     | , STA             |
|   | *008<br>*004                     | . 408                                      | , GDG<br>, GDR           | ,ROG               | ,PDG<br>,PDR      | 111115                  | , STA             |
| , | *UDR                             | , VDR<br>, VDM                             |                          | , MDR<br>, MDM     | .PDM,             | OOR<br>VOP              | STA               |
|   | ≠6DP                             |                                            | -665                     | , UDP              | , VD0             | 600                     | , STA             |
|   | ≠POO<br>REAL MO#                 | . 498                                      | , HTOV                   | HTDR               |                   |                         | STA               |
|   | COMMON/S                         | , ADV, ADR<br>TATES/                       |                          |                    |                   |                         | STA<br>STA        |
|   | <b>*SIN2RQ</b>                   | . CO52RB                                   | ,CO526M                  |                    |                   |                         | STA               |
|   | COMMON /                         |                                            | =                        | *                  | 1010/00           |                         | XCD               |
|   | *!TQ (                           |                                            | D),ITI<br>,NCMST         | ,INTB<br>,NSB      |                   | ), JPH (20,2<br>, NICNB |                   |
|   | *I20P                            | TCOR                                       | 16.91                    | IFAR               | 11-14             | 3 400                   | , XCO             |
|   | *10PEN                           |                                            | 1 S P H                  | . 1557             |                   | INTAKI                  | , xco             |
|   | +ITCT<br>+KOP                    | ,ITER<br>,KPST                             | ,ÎVAR                    | , JK<br>, KST      | ,JPS<br>,NAD      | ,JS<br>,NCASE           | XCO               |
|   | + NCN                            | - NEUB                                     |                          | NOP                |                   |                         | , xco             |
|   | *NST                             | .1751                                      | TLKIMI                   | ISTN               |                   | . 13180                 | XCO               |
|   | ≠IPHNB<br>≠IFOB                  | TREKI                                      | ,1BLK2                   | ISTOP              | ,15177            | , iL                    | , XCO             |
|   | *NCTIN                           | NEOF IL                                    | AB(8). JPRP              | MB<br>ISII,MTT,MPI | N(20).JP1 :       | 1P2. JP3                | , XCO             |
|   | CORMONZA                         |                                            |                          |                    |                   |                         | AEC               |
|   | *APHO<br>*SINA                   | APHR<br>COSA                               | ALPHA<br>PHIO            | , VDA              | , GDA             | ,PDA<br>,SINPHI         | , AEC             |
|   | +COSPHI                          | COVE                                       | PINPH                    | ,PHID<br>,XLAMA(9) | ,PHI<br>,XLAMP(9) |                         | . AEC             |
|   | *COOM                            | 131 10                                     | , F.K.                   | , XCGA             | ,ZCGM             |                         | AEC               |
|   | ≠CM<br>∓CLAM                     |                                            | LORDE LOR                | 1,CMD              | CADA              | FKM                     | AEC               |
|   | +CD<br>+CD                       | , CL<br>, CDA                              | , CLA<br>, CDM           | CLA                | •                 |                         | AEC               |
|   | *CD<br>COMMON/(<br>*OMG(20)      | SENF/                                      |                          |                    |                   |                         | GEN               |
|   |                                  | ,0MBP(20,                                  | 2), VARQ(9)              | ,TOL(9)            | ,SVAR(10)         | , MDC(20)               | , GEN             |
| • | *A(9,9}<br>*DTS                  | ACON(9)                                    | , BCDH(9)                | .COTI(9,9)         | DCDN(9)           | DTP<br>,us              | , GEN             |
|   | #R                               | ÂĖ                                         | BRICH                    | .PA                |                   | . 65                    | , SEN             |
|   | + VNU                            | ,ran                                       | .HOR                     | , CSH              |                   | , SUMSO<br>, TR( 9 )    | , GEN             |
|   | +5V5Q<br>+T5T(20)                | TIMEPH<br>TPH (2)                          | TIMES<br>0), DIS(20)     | ,TOP<br>,DIP(20)   | , IUS _           | _,TR(9)                 | , GEN             |
|   | *TLP1(20)                        | 1 .11.51 (29                               | 01.0TP1{201              | DIS1(20)           | TIME.             |                         | CEN               |
|   | +TIMPR                           | LIET                                       | .DRAG                    | .TAX               |                   | .TBU(20)                | , GEN             |
|   | +AE<br>≠BR                       | ,FP<br>,GV                                 | .FPOLD                   | .FPB               | , MACHR           | RACHY                   | , GEN             |
|   | *LIFTR                           | LIFTA                                      | FVAC                     | LIFTY              | DRAGR             | .DRAGA                  | GEN<br>GEN        |
|   | *                                | LÎFTN                                      | , DBR                    | .OB                |                   | icor                    | , GEN             |
|   | * *****                          | YMPeu                                      | ULFT                     | ULFTY              |                   | III F I B               | . GEN             |
|   | ≠XMCG<br>≠CULFT                  | , XACSV                                    | , XMCGR<br>, CALPHA      | , XMCGA<br>, CDE   | XMCGM<br>DELTAE   | CODAE                   | , SEN             |
|   | +C0p                             | CT<br>SIDAE<br>GENF /                      | ,×ce                     | 706                | , xJ              | ,                       | GEN               |
|   | Compon v                         | GENF /                                     |                          | •                  |                   | 446                     | GEN               |
|   | +XJV<br>+FRATED                  | XJR<br>IRATED                              | , GH                     | , GAMMAD           | , XKS             | , XKP                   | , GEN             |
|   | *P1                              | P7                                         | ,P3                      | , XK1              | , XK2             | , XK3                   | . GEN             |
|   | *XK1T                            | - ARCI                                     | XKST                     | , XK1D             |                   | 1830                    | , GEN             |
|   | ≠XK1A<br>≠XK1G                   | . XKZA                                     | . AKSR                   | . 35.1 V           |                   | XX.5 W                  | , GEN             |
|   | +XK1R                            | , XX26<br>, XX2R                           | . AK.5 b                 | , XK1P<br>, XK10   | , XK20            | , XK3P<br>***38         | . GEN             |
|   | +XK1U                            | , XK2(J                                    | , XX 3U                  | XKIN               |                   | , XK3B                  | . GEN             |
|   | ≠PV                              | .P6                                        | , XK3R<br>, XK3U<br>, PP | .PR                | .90               | .0PBY(3,8)              | GEN               |
|   | REAL LI                          | FTŘ , LIFT                                 |                          | n ,                | нзак,             | MÁCHR,                  | GEN<br>FRA        |
|   | DIMENSI                          | PF MACHY L<br>IN TPH1(10)<br>INCELTUPI, TH | รัรราช ใช <i>้</i> วัติ  |                    |                   |                         | GEN               |
|   | EDUTION                          | DOELTIES TO                                | us i ities to            | Tis                |                   |                         | SEN               |

```
I INITIALIZE COUNTERS
ENTRY BEGNB
KK= MCNST+1
IBLK1=0
IBUFB =0
RETURN
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COMM
COMM
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                                   76.
778.
79
81.
83.
85.
86.
  65T03
65T03
85T03
   BS103
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COMN
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BST03
  Ç
   II TERMINATE STORAGE IF PARTIAL BUFFER, DUMP BUFFER ENTRY ENDB MAXB = IBLKI
CALL IPR(ZHXL,XL,I,9*NCN,G)
IF(MAXB.NE.O)GO TO 10
MAXB=MXB
NBUFB= IBUFB
RETURN
                               88
89.
90.
91.
  10-
                               93.
94.
95
96.
97
   BST03
BST03
COMM
COMM
  10 NBUFB = 1BUFB +1
60 TO 94
  90-
   III STORE DATA IN BUFFER ENTRY BSTO
  ENTRY BSTO

20 CONTINUE
DD 40 121, KK
DD 30 J=1, KQ
DD 30 J=1, KQ
18LK1 = TBLK1+1
30 Z(1BLK1)= XL(J,I)
40 CONTINUE
DD 50 I=1, KK
18LK1=1BLK+1
50 Z(1BLK1)= XLAMA(I)
DD 60 I=1, KK
IBLK1 = TBLK1+1
60 Z(1BLK1)= XLAMP(I)
DD 80 JJ=1, KK
DD 70 K1=1,JJ
1BLK1 = IBLK1+1
70 Z(1BLK1)= XLAMP(I)
80 CONTINUE

  BSTOS
98.

98.

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  IV IF BUFFER FULL DUMP BUFFER ,ELSE RETURN
IF(IBLK1.SE.MXB) SO TO 96
RETURN

90 IBUFB = IBUFB +1
IF(IBUFB.GT NBFB) CALL STPIT(IFB)
CALL WRITMS(IFB,Z,MIXB,IBUFB)
IBLK1=0
RETURN
  90-
   B5T03
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C0MN
C0MN-
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B5T03
  RETURN
   V SPECIAL CODE TO REFINE MIDPOINT IMPULSE-RESPONSE
FUNCTION AND STORE DATA
ENTRY SNSAOJ
OC 100 1=1 NCN
XLARA(1)=XLARA(1)
100 XLAP(1)=XLARA(1)
CALL ADEG
OD 110 1=1 NCN
XLAMA(1)=(XLARA(1)+XLAR(1))*.5
110 XLARP(1)=(XLARA(1)+XLAR(1))*.5
GO TO 20
END
       127
128.
129.
130
131.
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133.
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135.
136.
  20-
```

20 OCT 72 6.01-46

# SUBRØUT I NE CØN3

#### Subroutine CON3

### Purpose

Subroutine CON3 computes the constraint misses and payoff. It has two entry points the first, CONIN, sets up and computes constraint misses, ACON, for the first nominal trajectory; whereas the entry CON computes trial constraint misses and payoff, BCØN. These trial constraint misses later become nominal values in subroutine TEST if the trial trajectory is acceptable.

#### Description

The main logic in this subroutine is governed first by the argument list (MM, MN) which indicates partitioning of the  $d\psi_i$  vector and second by the constraint variable code pointer ITQ.

MM is the first element in  $d\psi$ , to be evaluated and NN is the last.

The ITQ pointers tell whether the constraint or payoff is elapsed timed, an element of the state vector or a non-linear constraint.

| EURTHAN | MATR     | CODE | DESCRIPTION                                                 |         | RAS |      |                                                                                       |                            | USAGE                                                                                  |
|---------|----------|------|-------------------------------------------------------------|---------|-----|------|---------------------------------------------------------------------------------------|----------------------------|----------------------------------------------------------------------------------------|
| SYMBOL  | 24W8() F |      | DESCRIPTION                                                 | BLOCK   |     | LOC  | SUBK                                                                                  | CODE                       | . VAR                                                                                  |
| ACON    |          |      | Vector of nominal constraint misses + PAYOFF<br>IMPROVEMENT | /GENF   | /(  | 190) | CON3<br>TEST                                                                          | M<br>M                     | ACON<br>ACON                                                                           |
| BCON+   |          | 0    | Vector of constraint misses on trial trajectory             | /GENF   | /(  | 199) | CON3<br>TEST<br>TOPM                                                                  | O<br>I<br>I                | BCON<br>BCON<br>BCON                                                                   |
| DCON    | dΨį      |      | Asked for correction in constraint Pisses and payoff vector | /GENF   | 10  | 289) | CON3<br>MTX3A<br>PAYO2<br>TEST<br>TOPM<br>TRTOSS                                      | 0<br>I<br>M<br>M<br>I<br>I | DCON<br>DCON<br>DCON<br>DCON<br>DCON<br>DCON                                           |
| FPD     |          | I    | Rate of change of non-linear cut-off function               | /GENF   | /(  | 523) | CON3<br>DTF3<br>STP3<br>YREF3                                                         | I<br>I<br>I                | FPD<br>FPD<br>FPD<br>FPD                                                               |
| IOP     |          | W i  | Payoff code                                                 | /CDN3   | /(* | )    | CON3                                                                                  | M                          | IOP                                                                                    |
| 170     |          | I '  | Constraint option code (internal)                           | /XCQDES | 5/( | 1)   | ADICS:<br>ADICS:<br>ADIDS:<br>CONS<br>SDINP<br>STAU<br>TOPM                           | 1 6                        | 1 T Q<br>1 T Q<br>1 T Q<br>1 T Q<br>1 T Q<br>1 T Q<br>1 T T Q                          |
| NCNST   | n        | I (  | Number of problem constraints                               | /xcodes | 5/C | 132) | BGET3<br>BST03<br>CON3<br>PAY02<br>SDINP<br>SUMS<br>TEST<br>TOPM<br>TRAN3             | I<br>I<br>I<br>I<br>I<br>I | NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST |
| TIME    | t        | 1    | Time (stapsed)                                              | /GENF   | /(  | 493) | ADICBS AST3 BNTG CON3 DTN3 ENVPRI EQUAS FNTG MODEL4 OUT PDBC PROP1! REU3 RKT63/ YREF3 | 0                          | TIME TIME TIME TIME TIME TIME TIME TIME                                                |

| FORTRAN<br>SYMBOL | MATH<br>Symbol | CODE      | DESCRIPTION            |          | STO<br>BLOCK | RAGE<br>LOC | <u> </u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | E USAGE<br>E VAR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|----------------|-----------|------------------------|----------|--------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   |                |           |                        |          | 0200         |             | 003                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| VAR               | V              | I Relativ | e velocity             | (FT/SEC) | /STATE3      | /C 1        | ACCEL I BL4 I BL4 I BL5 I BCR3A I DTF3 I ECUA3 I MCDELA I MCD | A 100 M A 100 |
| VARQ              | (VARQ)         | I Desired | constraint values [sd] |          | /GENF        | /( 61       | CON3 I<br>SDINP M<br>TEST I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | VARQ<br>VARQ<br>VARQ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

```
1.
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115.
   SUBROUTINE CONSCHM, NH)
   0000000
  COMN
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COMN
   COMPUTE CONSTRAINT AND PAYOFF VALUES AT APPROPRIATE ARC END POINTS
   MM IS THE SET NO OF THE FIRST CONSTRAINT NA IS THE SET NO. OF THE LAST CONSTRAINT
   COMN
COMN
   | COURN COMN COMN COMN COMN COMN COMN COMN CODES | COD
   COMMON /XCODES/
#1TQ (9),1COR
#JST (20)
#120P ,1COP
   INTB
NSB
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IF(MM.GT.NN) GO TO 50

DO 40 1=44,UM

JJ = ITQ(I) -1

IF(JJ.EQ.O) GO TO 30
   50-
   CONS
  3G-
20 BCT 72 6.01-96
```

| 76<br>77.<br>78        | IF(JJ.LE. 9) 60 TO 10<br>Call PDBC(ITQ(I),Z,SX,FPD,O,ISKP)<br>ACON(I) = VARQ(I) - Z        | CON3<br>CON3<br>CON3 | 15-          |
|------------------------|--------------------------------------------------------------------------------------------|----------------------|--------------|
| 79<br>80 10            | GO TO 20<br>CONTINUE                                                                       | CON3                 | 26-1         |
| 81<br>82               | IF(J]_EQ 9) JJ=8<br>ACON(I)=VARQ(I)-VAR(JJ)                                                | CONS                 | 1 111        |
| 83 20<br>84            | DCON(1) =ACON(1)<br>GD TO 40                                                               | CON3<br>CON3         | 45           |
| 85 30<br>86.           | ACON(1) = VARQ(1) - TIME<br>DCON(1) = ACON(1)                                              | CON3<br>CON3         | <b>†</b>     |
| 87 40                  | CONTINUE                                                                                   | COM3                 |              |
| 88 50<br>89 60<br>90   | IF(NN LT NCNST) RETURN<br>10P= 1TQ(NCNST+1) -1                                             | CON3<br>CON3<br>CON3 | 80—          |
| 91.<br>92.             | IF(10P.E3.0) 60 TO 80<br>IF(10P.LE.9) 60 TO 70<br>CALL POBC( ITQ(NCNST+1),Z,SX,FPD,O,ISKP) | CON3<br>CON3         | 78           |
| 93.<br>94.             | ACON MCMST+1)= I                                                                           | CON3<br>CON3         |              |
|                        | CONTINUE<br>IF(IOP.EQ.9) IOP=8                                                             | CON3<br>CON3         |              |
| 97<br>98               | ACON(NCNST+1) = VAR(10P) RETURN                                                            | CON3                 |              |
| 99 80<br>100.          | ACON(NCNST+1) = TIME<br>RETURM                                                             | COM3                 |              |
| 101. C<br>102. C       | II CONSTRAINT MISSES AND PAYOFF FOR TRIAL TRAJECTORY                                       | COMM                 | }            |
| 103. C<br>104.<br>105. | ENTRY COM                                                                                  | COMN<br>COM3<br>COM3 | 1            |
| 106.<br>107.           | 15(Am.GT.NH) GD TO 120<br>DG 110 I=AM,NN                                                   | CON3<br>CON3         | 120          |
| 198<br>199             | JJ = 118(1)+1                                                                              | CON3<br>CON3         | 100          |
| 110<br>111             | IF(JJ_E0_0) 60 TO 100<br>1F(JJ_LE 9) 60 TO 90<br>Call_Pobc(ITG(1),Z,Sx,FPD,O,1SKP)         | CON3                 | 90           |
| 112<br>113             | BCON(I)= VARQ(I) - Z<br>GO TO 110                                                          | CON3<br>CON3         | 110-         |
| 115                    | CONTINUE<br>IF(JJ.EQ.9) JJ=8                                                               | COM3<br>COM3         |              |
| 116                    | BCON(I) = VARQ(I)- VAR(JJ)<br>GD TO 110                                                    | CON3<br>CON3         | 110          |
|                        | BCON(1) = VARQ(1)- TIME CONTINUE                                                           | CON3                 | <del> </del> |
| 121. 130               | IF(NA LT.NCNST) RETURN<br>IOP = ITG(NCNST+1)                                               | CON3<br>CON3         | 1            |
| 122.<br>123.           | IF(10P.EQ.1) 60 TO 150<br>IF (10P.EE.10) 60 TO 140                                         | CON3<br>CON3         | 150          |
| 124.<br>125.<br>126.   | CALL POBCC ITG(NCMST+1),Z,SX,FPD,O,ISKP) BCDN(NCMST+1)= Z RETURN                           | CON3<br>CON3<br>CON3 |              |
|                        | CONTINUE<br>FF(IOP.EQ 10) IDP=9                                                            | CON3<br>CON3         |              |
| 129.<br>130.           | BCON(NCRST +1) = VAR(10P-1) RETURN                                                         | CON3<br>CON3         | ] [          |
| 131 150<br>132<br>133. | BCON(NCNST +1) = TIME<br>RETURN<br>END                                                     | CON3<br>CON3<br>CON3 |              |
|                        |                                                                                            |                      |              |
|                        |                                                                                            |                      |              |
|                        |                                                                                            |                      | 1            |

# SUBRØUT I NE DER3A

#### Subroutine DER3A

## Entry Points DER

### Purpose

Subroutine DER3A computes the derivatives of the equations of motion for the forward steepest descent trajectory.

#### Description

The equations programmed in subroutine DER3A are given in Volume I, Section 2.3. The acceleration vector component AV, AG, AP and AM are computed in subroutine ACCEL.

| ORIBAN | MATH            | CODE | DESCRIPTION                  |             | STORA     | 6 <u>E</u> | SUAROU                                                                            |                       |                                                                                                  |
|--------|-----------------|------|------------------------------|-------------|-----------|------------|-----------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------|
| SYMBOL | SYMBOL          |      | - DESCRIPTION                | ·           | BLULK     | LOC        | SUBA                                                                              | CODE                  | VAR                                                                                              |
| AG     | а <sub>2</sub>  | 1    | Acceleration vector element. |             | /AXL /(   | 2)         | ACCEL<br>DER3A<br>PDY3A                                                           | M                     | AG<br>AG<br>AG                                                                                   |
| AM     | e m             | 1    | Acceleration vector element. |             | /AXL /(   | 4)         | ACCEL<br>DER3A                                                                    | M                     | AM<br>AM                                                                                         |
| AP     | a⁴              | I    | Acceleration vector element. |             | /AXL /(   | 3)         | ACCEL<br>DER3A<br>PDY3A                                                           | M<br>I<br>I           | AP<br>AP<br>AP                                                                                   |
| AV     | a v             | 1    | Acceleration vector element. |             | /AXL /(   | 1)         | ACCEL<br>DER3A                                                                    |                       | AV<br>AV                                                                                         |
| COSGAM | cos(7)          | 1    | See symbol                   |             | /STATE3/( | 687)       | ACCEL<br>BL4<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>OUT<br>POBC<br>PDY3A | I<br>I<br>I<br>O<br>I | COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM |
| COSPSI | cos( <b>∳</b> ) | I    | See symbol                   |             | /STATE3/( | 705)       |                                                                                   | I<br>I<br>I<br>O<br>I | COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI           |
| СОЅЯНО | cσs(ρ)          | I    | See symbol                   |             | /STATE3/( | 707)       | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>DUT<br>POBC<br>POY3A   | I<br>I<br>I<br>Î      | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO |
| G      | g               | 1    | Gravitational attraction     | (FT/SEC++2) | /GENF /(  | 301)       |                                                                                   | I<br>I<br>I<br>M      | 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6                                                          |
| GD     | · •             | 0    | GAM derivative               |             | /STATE3/( | 16)        | DER3A<br>PDBC                                                                     | 0                     | GD<br>GD                                                                                         |
| GMDOT  | 7*              | I    | Pitch rate                   | (DEG/SEC)   | /ARCDAT/( | 15)        | DERSA<br>MODELA<br>MODELB<br>PROPB<br>PROPIN                                      | I<br>I<br>I           | GMDOT<br>GMDOT<br>GMDOT<br>GMDOT<br>GMDOT                                                        |
| HD     | h               | 0    | ALT derivative               |             | /STATE3/( | 17)        | DER3A<br>PDBC                                                                     | 0<br>I                | HD<br>HD                                                                                         |
| нто    | Ġ               |      | Heating decivative           |             | /STATE3/( | 22)        | DER 3 A<br>DUT<br>POBC<br>PDY 3 A                                                 |                       | 0 TH<br>0 TH<br>0 TH<br>0 TH                                                                     |

| ORTRAN<br>Symbol | MATH<br>5ymbol | CODE | DESCRIPTION                                     | <u>STORAI</u><br>Block | LOC  | SUBROUTINE<br>SUBB CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | US A GE                                                                              |
|------------------|----------------|------|-------------------------------------------------|------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
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| <b>161</b> 1     |                | I    | Control option                                  | /XCODES/(              | 195) | BNTG O J<br>DER3A I J<br>FNTG M J<br>GUI3A I J<br>MODELA I J<br>MODELB I J<br>MTX3A I J                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | GII<br>GII<br>GII<br>GII<br>GII<br>GII                                               |
| JPRP             |                |      | Propulsion flag for different rocket options    | /xcodes/(              | 194) | DERSA I J<br>EQUAS I J<br>MODELA I J<br>PDYSA I J<br>PROPB O J                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | PRP<br>PRP<br>PRP<br>PRP<br>PRP                                                      |
| dh               | m              | 0    | MASS derivative                                 | /STATE3/(              | 18)  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1D<br>1D                                                                             |
| OCORHO           | ω×COSRHO       | I    | See symbol                                      | /STATE3/(              | 708) | DER3A I 0<br>EQUA3 M 0<br>MODELA I 0<br>MODELB I 0<br>PDBC I 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CORHO<br>CORHO<br>CORHO<br>CORHO<br>CORHO<br>CORHO                                   |
| OCORO2           | ω×OCORHO       | I    | See symbol                                      | /STATE3/(              | 709) | EQUAS 0 0<br>MODELA I 0<br>MODELB I 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CORO2<br>CORO2<br>CORO2<br>CORO2<br>CORO2                                            |
| 0 D              | è              | Đ    | Latitude derivative                             | /STATE3/(              | 20)  | DER3A 0 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ם                                                                                    |
| OMGZ             | ω              | 1    | Earth rotation rate (RAD/SE                     | C) /GLOBAL/(           | 3)   | CRASH I ODERSA I ODER | IMGZ<br>IMEGA<br>IMEGZ<br>IMGZ<br>IMGZ<br>IMGZ<br>IMGZ<br>IMGZ<br>IMGZ<br>IMGZ<br>IM |
| PSID             | ż              | 0    | Azimuth derivative                              | /STATE3/(              | 19)  | DER3A 0 P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | SID                                                                                  |
| QMULT            | =0 0R 1        | 1    | Heating flag ≡ultiplier                         | /ARCDAT/(              | 40)  | FXDAT 0 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TJUME<br>TJUME<br>TJUME                                                              |
| R                | R              | Ī    | Radial distance from earth center to vehicle (F | T) /GENF /(            | 305) | BL4 I R<br>BL7 I R<br>BL8 II R<br>DER3A I R<br>EQUAS M R<br>MODELA I R<br>MODELB I R<br>POBC I R<br>PDY3A I R<br>TRTOSZ I R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                      |
| RDI              |                | I    | Angle to radian conversion, 01745329252         | /DATA /(               | 3)   | BLICO I R DERSA I R FNTG I R GUISA I R MODELA I R MODELA I R PAOSI D R PROPIN I R REUS I R SDINP I R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ROI<br>ROI<br>ROI<br>ROI<br>ROI<br>ROI<br>ROI<br>ROI<br>ROI                          |

| FORIHAN<br>Symbol | MATH<br>Symbol         | 000 | DESCRIPTIO                         | N                           | STORAG<br>BLOCK | E<br>LUL | SUBROUTIN<br>SUBB COD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                  |
|-------------------|------------------------|-----|------------------------------------|-----------------------------|-----------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| RHOB              | Pb                     | i   | Atmosphere base density for heatin | g calculation<br>(LB/FT++3) | /ARCDAT/(       | 39)      | DER3A I<br>FXDAI O<br>PDY3A I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | RHOB<br>RHOB<br>RHOB                                                                             |
| RO                | ρ <sub>a</sub>         | 1   | Atwospheric density                | (SLUGS/FT**3)               | /GENF /(        | 309)     | BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 I<br>OUT I<br>PDBC I<br>PDY3A I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 80<br>80<br>80<br>80<br>80<br>80                                                                 |
| SINGAM            | sin(2)                 | 1   | See symbol                         |                             | /STATE3/(       | 688)     | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>POBC I<br>POY3A I<br>SDER3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM           |
| S I NPS I         | sin(∤)                 | I   | See symbol                         |                             | /STATE3/(       | 704)     | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>POBC I<br>PDY3A I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI           |
| S I NR HO         | sin(ρ)                 | I   | See symbol                         |                             | /STATE3/(       | 706)     | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>OUT I<br>POBC I<br>POBC I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO |
| SQRT              |                        | F   | Square root function               |                             | /SQRT /(\$      | )        | ANLATM F CRASH F CRASH F DCTOE F DENVPRM F HUNT F MODELL F MODELL F MODELL F PAY62 F P | SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT                                     |
| UD                | $\overset{\cdot}{\mu}$ | 0   | Longitude derivative               |                             | /STATE3/(       | 21)      | DER3A O<br>PDBC I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 9<br>9                                                                                           |

| FORTRAN | MATH   |                |                                |             | STORAGE   |     | SUBROUTINE USAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                    |  |
|---------|--------|----------------|--------------------------------|-------------|-----------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|--|
| SYMBOL  | SYMBOL |                | DESCRIPTION                    | <del></del> | нгоск     | LOC | SUBR CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DE VAR                                                             |  |
| V       | V      | I Relative vei | oclty                          | (F1/SEC)    | /STATE3/( | 1)  | ACCEL I ADICAS C AOJUST M AGETBS C ASTS I BL4 I BL7 I BL8 I CONS | VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR |  |
| ΨB      | ÿ      | D State vector | derivatives in steepest descen | nt ≋adule   | /STATE3/( | 15) | YREF3 MADICBA | DVAR DVAR LVAR LVAR LVAR DVAR DVAR DVAR DVAR DVAR DVAR DVAR D      |  |

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SUBROUTINE DERSA
1237567890123456789012345678901234567890123
   DER3A
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  COMPUTE DERIVATIVES OF EQUATIONS OF MOTION
   COMMON/DATA/
*P1 ,RAD
*FTNM CAR
COMMON /XCODES/
*ITO (9),ICOR
*JST (20)
  DATA
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   RDI
JOP1
  ,UMF
,JOP3
  ,IMPF
,JOP4
  ,5C
,J0P2
  JGIO(20,2), JPH (20,2),
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IFB IHD
IARC ISTART
,JPS JS
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*UDV SDG GOG
*UDG YOM GOM
*UDG YOM GOM
*UDG YOM GOM
*SOP PDP ODP
*PDO UDO
REAL MOM MDV MDR
COMMON/STATES/
*SINZEO COSZRO COSZGM
**COMMON/STATES/
**TOMON/STATES/
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ULFT
XHCGR
CALPHA
XCG
   ULFIV
XMCGA
CDE
ZCG
   ISP
ULFTR
XMC6M
DELTAE
  , GH
  , XKG
  , XKP
   , GAMMAD,
   P3 , XK1

XK3T , XK1D

XK3A , XK1V

XK3A , XK1V

XK3G , XK1D

XK3B , XK1D

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RETAP
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   *, ITPSD , KSOL , KGLOBL(8)
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*SREF ,EJ , XISP
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*XLMAX , HOMAX , GMDDI
*MAEB , MAEC , MAED
*MT , MISP , MXCG
XISP
JAER
GMDDT
MAED
MXCG
ZCGR
RHOB
   OTPI
GHAX
MAEA
MAEG
MUDB
  TMULT
JPRO
ALFMAX
MAEE
MZCG
XE
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OMAX
PHMAX
MAEF
MUDA
ZE
REMAX
  * FRATE ARCD(*)
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*SINA COSA PHIO PHID
*COSPNI GDPH POPH XLAMA(*9
*CODOM CLO FK XCSM
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*CLAM CLA CLAM CMM CMO
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*ENTRY DER
*I FROCKET COMPUTE SPECIFIC IMPULSE
*IF (JPRP-CT 1) CALL IMPUL
**II COMPUTE ACCELFRATION VECTOR
  ARCOAT
AECO3
   ,GDA
,PHI
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,XCSM
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VD= R****OCORO2**( COSRHO***SINGAM**** SINRHO****COSPSI***COSGAM) -G****SINGAM***
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123
   CONTINUE
GD= DCORHO+(2 *SINPSI+R*OMSZ/V*(COSRHO+COSGAM+ SINRHO+COSPSI*SING DER3A
1AM)) + COSGAM+(V/R-S/V) + AS
10
   * / V * COSGAM*SINPSI/(R*COSRHO)+2*0MGZ) + AP 10

PSID = 0CORHO*( R* DMGZ*SINRHO*SINPSI/V-2 *COSPSI*SINGAM)/ COSGAM* DER3A
DER3A
* / ( V*COSGAM*SINPSI/(R*COSRHO)+2*0MGZ) + AP 10
  * / ( V*COSGAM)

20 CONTINUE

RD= AH

HD = V*SINEAM

OD= V* COSGAM*COSPSI/R

UD= V*COSGAM*SINPSI/(R*COSRHO)

IF( QRULT*RO EQ O ) RETURN

HTD= QRULT* 17600 *SQRT(RD/RHOB) *(V/26000.)**3 15

RETURN

END
  DERSA
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APRZ7
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130
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# SUBRØUT I NE DTF3

#### Subroutine DTF3

## Entry Point, DTF

### Purpose

Subroutine DTF3 computes integration interval to approximately hit a state or function cut-off.

### Description

After the forward integration controlling subprogram, FNTG, detects that an arc cut-off is imminent, DTF3 is called to estimate the integration interval to satisfy the cut-off function. This is done using the equations described in Volume I, Section 15.2, equations 15.2-3 through 15.2-11.

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE     | DESCRIPTION                                                    | <u>ST</u><br>BLOU | ORAG<br>(  | <u> </u> | <u> </u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  | USAGE<br>VAR                                                                                              |
|-------------------|----------------|----------|----------------------------------------------------------------|-------------------|------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------|
| AA                |                | ••       |                                                                | /0753             |            |          | DT E 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | T.8              | ^^                                                                                                        |
|                   |                | <b>⊔</b> | Coefficients in compute interval formula                       | /01F3             | /(+        |          | DTF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <u>u</u>         | AA<br>A3                                                                                                  |
| A2                |                | W        | Coefficients in compute interval formula                       | /DTF3             | /(+        |          | DTF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | u                | A2                                                                                                        |
| В                 |                | W        | Coefficients in compute interval formula                       | /DTF3             | /(+        |          | DTF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | W                | В                                                                                                         |
| C                 |                | ᅵᅵ       | Coefficients in computa interval formula                       | /DTF3             | /(+        |          | DTF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | W                | C                                                                                                         |
| FP                |                | 1        | Current value of cut-off function - non-Irnear only            | /GENF             | R          | 521)     | DTF3<br>STP3<br>TOL3<br>YREF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | I<br>I<br>I      | FP<br>FP<br>FP                                                                                            |
| FPD               |                | 1        | Rate of change of non-linear cut-off function                  | /GENF             | /(         | 523)     | CON3<br>DTF3<br>STP3<br>YREF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1<br>1<br>1<br>1 | FPD<br>FPD<br>FPB<br>FPB                                                                                  |
| FPOLD             |                | 1        | Value of non-linear cut-off function at prior compute interval | /GENF             | /(         | 522)     | DTF3<br>STP3<br>TOL3<br>YREF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | I<br>0<br>0<br>1 | FPOLD<br>FPOLD<br>FPOLD<br>FPOLD                                                                          |
| Н                 |                | щ        | Change in Ω from last to current compute interval              | /DTF3             | /(+        | )        | BTF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | W                | H                                                                                                         |
| HP                |                | W        | Current error in $\Omega$                                      | /DTF3             | /(*        | )        | DTF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | bi               | HP                                                                                                        |
| REZ               |                | ы        | Ratio of HP/H                                                  | /DTF3             | /(*        | )        | DTF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 냂                | REZ                                                                                                       |
| SVY               | y_1            | I        | State and time array at previous compute interval              | /STATE            | 3/(        | 236)     | DTF3<br>REU3<br>YREF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | I<br>M<br>I      | 5 VY<br>5 VY<br>5 VY                                                                                      |
| TIME              | t              | Ī        | Time (elapsed)  Relative velocity (FT/SEC)                     | /GENF             | <i>?</i> ( |          | ADICES ASTIGUAS ASTIGUAS CONSTRAM CONTSTRAM EQUAS FNOELA PODECA PROUDECA PREUS RKTESS ACCEL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | HIIIIHHIIII      | TTIMEE<br>TTIMEE<br>TTIMEE<br>TTIMEE<br>TTIMEE<br>TTIMEE<br>TTIMEE                                        |
|                   | V              | •        |                                                                |                   |            | .,       | ADJUBST ADJUBS A |                  | YAR<br>YAR<br>YAR<br>YAR<br>Y YAR<br>Y YAR<br>Y YAR<br>Y YAR<br>Y YAR<br>Y YAR<br>Y YAR<br>Y YAR<br>Y YAR |

| FORTHAN<br>SYMBOL | MAIH<br>Symbol | CODE   | DESCRIPTION                                     | STORA<br>BLOCK | LOC | <u>\$ 9880 0</u><br>\$ 988                          | INE USAGI                        |
|-------------------|----------------|--------|-------------------------------------------------|----------------|-----|-----------------------------------------------------|----------------------------------|
| VT                | ÿ              | 1 Stat | e vector derivatives in steepest descent module | /STATE3/(      | 15) | ADIC3A<br>ADID3A<br>DER3A<br>DTF3<br>ENVPRM<br>PDBC | I DVAR<br>M DVAR<br>O VO<br>I VT |

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,SAVBP(15)
,OCORO2
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00S
00R
VOP
600
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GENF
GENF
GENF
GENF
GENF
GENF
GENF
  NF/

OMEP(20,2), VARRO(9),

ACON(9), BCON(9),

DT 6,

RE MACH,

PAR, ROR,

TIMEPH TIMES,

TH (20), D191(20),

TLS1 (20), D1P1(20),

LIFT FPOLD,

AV FVAC,

LIFTA DBR
WBC(26)
DTP
QS
CS
SUMSQ
TR(9)
W
OMP
TBU(20)
MACHY
  TOL(9) SVAR(10)
COTI(9,9) DCON(9)
DPSQ Q
PA RO
CSR YNN
TOP TOS
DIP(20) T
   DIP(20)
DIS((20)
TAX
FPD
LIFTY
DRAGY
DB
ULFTY
XMCGA
CDE
,ZCG
  GENFF
GENF
GENF
GENF
GENF
GENF
GENF
  ORAGR
ISP
ULFTR
XMCGM
DELTAE
XJ
   DRAGA
ISPF
ULFTA
CODAE
SID
  LIFTM DBR

**COLLET CT CALPHA COLLET CT CALPHA 
  *LIFTR
  DBR
ULFT
XMCGR
CALPHA
XCG
  GENF
GENF
   GAMMAD,
   , XKG
  ,XKP
  GENF
   , XK1
, XK1D
, XK1V
, XK1P
, XK1D
, XK1M
, PR
  , XK2
, XK2B
, XK2V
, XK2P
, XK2O
, XK2M
, PO
  , XK3
, XK3D
, XK3V
, XK3P
, XK3O
, XK3M
, XF3M
, XF0H(3,
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GENF
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GENF
GENF
GENF
   MACH,
  SENF
GENF
  DTF3
DTF3
DTF3
DTF3
  COAN
COAN
OTF3
COAN
                                Ç
  I TEST FOR FUNCTION CUT-OFF YES 60 TO IF(I.ST.7) 60 TO 20
   111
  20
                                 Ç
   II STATE CUT OFF PRELIM CALC. H= V(I) - SVV(I+1) HP = OM - V(I) VTI = VT(I)
   COAN
DTF3
DTF3
   DIF3
  DTF3
COMN
 62.
63.
65.
66.
67.
68.
71.
71.
73.
   10 CONTINUE
                            Ç
  II-A TEST FOR PASSING CUT-OFF IF ( ABS(H).LT.1.E-10) GO TO 30
  COMM
  DTF3
COMM
COMM
  30-
   11-B CALCULATE TRUNCATED INTEGRATION STEP USING QUADRATIC APPROXIMATION
   COAN
  REZ= HP/H
AA= (1.+REZ)
A2=REZ+REZ
  0TF3
0TF3
0TF3
0TF3
0TF3
0TF3
0TF3
   TATALETRICE

= A2*AA

= TAA*(1.-A2)

AAT 1.-B

DTF3= AA*SVY(1)+B*TIME +C*H /VTI - TIME
```

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```
76.
77. C
78. C
79.
80.
81.
82
83.
84.
                                    RETURN
   OTF3
COMN
COMN
OTF3
DTF3
OTF3
DTF3
DTF3
DTF3
                          III FUNCTION CUT OFF PRELIM. CALC

20 H= FP-FPOLO
HP=OM -FP
YTI= FPO
GO TO 10

30 DTF =0.
RETURN
END
```

# SUBRØUT I NE EL 1

#### Subroutine EL1

## Entry EL1001, EL1000

## Purpose

Subroutine EL1 is a governing equation for the computation of the engine, deflection component of the in-plane control vector. It corresponds to fixed engine deflection.

## Description

The in-plane control vector computation is described in Volume I, Section 9.

| FORTHAN<br>SYMBUL | MAIH<br>Symbol | CODE | DESCRIPTION                                                                       |                        | BLOCK | 784 ₁€<br>UUU |                                    |                                         | USAGE<br>VAR                                   |
|-------------------|----------------|------|-----------------------------------------------------------------------------------|------------------------|-------|---------------|------------------------------------|-----------------------------------------|------------------------------------------------|
| COE               |                | 1 (  | Constant value of engine deflection                                               | (RAD)                  | /GENF | /( 55         | PROPB                              | 1<br>0<br>1 0                           | COE<br>COE<br>COE                              |
| DELTAE            | <sup>8</sup> E | 1 1  | Engine gimbai defiection angla                                                    | (RAD)                  | /GENF | /( 55         | BLGCOM<br>EL1<br>OUT<br>REU3<br>VT | I M I I I I I I I I I I I I I I I I I I | DELTAE<br>DELTAE<br>DELTAE<br>DELTAE<br>DELTAE |
| XK2               |                | 0 5  | Second control vector governing equation on trivial corresponds to error in momen | value. If<br>t balance | /GENF | /( 573        | EL1                                | 0                                       | XK2<br>XK2                                     |
| XK2D              |                |      | Partial of governing equation wrt state of vector component                       | r control              | /GENF | /( 579        | ) ACCEL<br>BLGCOM<br>EL1<br>EL2    | I<br>I<br>0<br>0                        | XK2D<br>XK2D<br>XK2D<br>XK2D                   |

```
INNERNATION FREE PROPERTY OF THE PROPERTY OF T
TOL(9) SVAR(10)
COTI(9,9) DCON(9)
OPSQ Q
PA AO
CSR VNR
TOP TOS
OIP(20) TIME
IAX TBURN
FPD MACHR
LIFTV DRAGR
DB ISP
ULFTV ULFTR
XMCGA XMCGM
COE DELTAE
ZCG
  UBC(20)
DTP
QS
CS
SUMSQ
TR(9)
OMP
TBU(20)
MACHY
  **CORPORT OF THE PROPERTY OF T
  DRAGA
ISPF
ULFTA
CODAE
,SIO
   DBR
ULFT
XMCGR
CALPHA
XCG
   ,GAMMAD
  , XKP
   , KKG
  ,XK3
,XK3D
,XK3P
,XK3D
,XK3D
,XK3M
   GENF
GENF
GENF
GENF
GENF
GENF
GENF
GENF
   , XK2
, XK2D
, XK2V
, XK2P
, XK2P
, XK2M
, PO
   MACH, MÁCHR,
  AECO3
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ELL1
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   ALPHA , VDA
PHID , PHID
PDPH , XLAMA(9)
FK , XCGM
CMAM , CMM , CMO
CLA , CLA
   ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
  PDA
SINPHI
COO
CLOM
FKM
   C
```

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# SUBRØUT I NE EL2

#### Subroutine EL2

Entry Points. EL2010, EL2001, EL2000

#### Purpose

Subroutine EL2 is a governing equation for the computation of the engine deflection component of the in-plane control vector.

It corresponds to variable engine deflection to balance all or part of the aerodynamic moment.

#### Description

The governing equation, XK2, computed in EL2, represents the balance of the aerodynamic moment given in Volume I, equation 3.1-12 by the engine moment as given in 3.1-17. The complete description of the in-plane control vector calculation is given in Section 9 of Volume I. The entry points, are used for separating the calculation of partials derivatives of XK2 with respect to in-plane control vector elements and with respect to the state vector.

| FORTRAN | MATH                       | CODE DESCRIPTION                                                                                       | STORA     |      | <u> 5 มคลอบโ</u>                                                                                                   |                                                                                             |                                       |
|---------|----------------------------|--------------------------------------------------------------------------------------------------------|-----------|------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------|
| SYMBOL  | SYMBOL                     | DESCRIPTION                                                                                            | BLOCK     | roc  | SUBR (                                                                                                             | 300                                                                                         | VAR                                   |
| COD     | cos( & <sub>E</sub> )      | 1 See symbol                                                                                           | /GENF /(  | 556) | EL2<br>OUT<br>VT                                                                                                   | I<br>I                                                                                      | COO<br>COD<br>COD                     |
| S10     | sin(s <sub>E</sub> )       | I See symbol                                                                                           | /GENF /(  | 555) |                                                                                                                    |                                                                                             | S10<br>S10<br>S10                     |
| ī       | Ţ                          | I Thrust (LBS                                                                                          | /GENF /(  | 411) | ACCEL<br>BLGCON<br>BL4<br>BL4<br>BL7<br>BL8<br>EL2<br>EQUA3<br>FH1<br>FH2<br>FH3<br>IMPUL<br>OUT<br>PROPIN<br>REU3 | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | T T T T T T T T T T T T T T T T T T T |
| XCG     | хce                        | 1 Center of gravity body x station (FT                                                                 | /GENF /{  | 558) | SDER3<br>EL2<br>EQUA3<br>VT                                                                                        | I                                                                                           | T<br>XCG<br>XCG<br>XCG                |
| XCGM    | 9X <sup>CG</sup> \9₽       | 1 See symbol                                                                                           | /AEC03 /( | 38)  | EL2<br>EQUA3<br>VT                                                                                                 | I<br>O                                                                                      | XCGM<br>XCGM<br>XCGM                  |
| XE      | Χ <sub>E</sub>             | I Engine thrust centroid body x station                                                                | /ARCDAT/( | 34)  | EL2                                                                                                                | I                                                                                           | ΧĒ                                    |
| XJ      | j                          | 1 Control blend factor                                                                                 | /GENF /(  | 560) | ELZ<br>EQUA3<br>OUT<br>VT                                                                                          | I<br>I                                                                                      | XJ<br>XJ<br>XJ                        |
| XJR     |                            | 1 Partial of blend factor of altitude                                                                  | /GENF /(  | 562) |                                                                                                                    | 1                                                                                           | XJR<br>XJR<br>XJR                     |
| ATA     |                            | I Partial of blend factor mrt velocity                                                                 | /GENF /(  | 561) | EL2<br>EQUA3<br>VT                                                                                                 | I<br>O<br>I                                                                                 | X1A<br>X1A<br>X1A                     |
| XK2     |                            | O Second control vector governing equation value. I non-trivial corresponds to error in moment balance | /GENF /(  | 573) | EL1<br>EL2                                                                                                         | 0                                                                                           | XK2<br>XK2                            |
| XK2A    |                            | 0 Partial of governing equation art state or control vector component                                  | /GENF /(  | 582) | ACCEL<br>Blgcon<br>El2                                                                                             | I<br>1<br>0                                                                                 | XK2A<br>XK2A<br>XK2A                  |
| XK20    |                            | O Partial of governing equation art state or control vector component                                  | /GENF /(  | 579) | ACCEL<br>BLGCON<br>EL1<br>EL2                                                                                      | I<br>1<br>0<br>0                                                                            | XK2D<br>XK2D<br>XK2D<br>XK2D          |
| XK2M    |                            | O Partial of governing equation art state or control vector component                                  | /GENF /(  | 603) | EL2                                                                                                                | 0                                                                                           | XK2A                                  |
| XK2R    |                            | O Partial of governing equation wrt state or control vector component                                  | /GENF /(  | 594) | EL2                                                                                                                | 0                                                                                           | XK2R                                  |
| XK2T    |                            | O Partial of governing equation art state or control vector component                                  | /GENF /(  | 576) | BLGCON<br>EL2                                                                                                      |                                                                                             | XK2T<br>XK2T                          |
| XK2V    |                            | O Partial of governing equation mrt state or control<br>vector component                               | /GENF /(  | 585) | EL2                                                                                                                | 0                                                                                           | XK2¥                                  |
| XMCG    | $M_{\mathbb{C}\mathbf{G}}$ | I Aerodynamic moment about center of gravity (FT-LBS                                                   | /GENF /(  | 544) | EL2<br>OUT<br>VT                                                                                                   | I<br>I<br>M                                                                                 | XMCG<br>XMCG<br>XMCG                  |
| XMCGA   |                            | I Partial of XMCG wrt angle of attack                                                                  | /GENF /(  | 547) | EL2<br>VT                                                                                                          | I<br>M                                                                                      | XMCGA<br>XMCGA                        |

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| FORTRAN<br>Symbol | MATH<br>Symbol       | CODE DESCRIPTION                        |      | 51(<br>BLOCK | RAC | E<br>LOC | SUBADI<br>SUBA     |             | E USAGE<br>E VAR     |
|-------------------|----------------------|-----------------------------------------|------|--------------|-----|----------|--------------------|-------------|----------------------|
| XMCGM             |                      | I Partial of XMCG ort mass              |      | /GENF        | /(  | 548)     | EL2                | I           | XMCGM<br>XMCGM       |
| XMCGR             |                      | I Partial of XMCG wrt aititude          |      | /GENF        | /(  | 546)     | • •                | I           | XMCGR<br>XMCGR       |
| XMCGV             |                      | I Partial of XMCG wrt velocity          |      | /GENF        | 16  | 545)     | EL2<br>VT          | I<br>M      | XMCGV                |
| ZCG               | Z <sub>CG</sub>      | I Center of gravity body z station      | (FT) | /GENF        | /(  | 559)     | EL2<br>EQUA3<br>VI | I<br>I<br>I | ZCG<br>ZCG<br>ZCG    |
| ZCGM              | aZ <sub>CG</sub> /am | I See symbol                            |      | /AEC03       | /(  | 39)      | EL2<br>EQUA3<br>VI | 1<br>0<br>1 | ZCSM<br>ZCGM<br>ZCGM |
| ZE                | z <sub>e</sub>       | I Engine thrust centroid body z station |      | /ARCDAT      | 1/( | 35)      | EL2<br>VT          | 1           | ZE<br>ZE             |

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   NF/
, ORGP(2G,2), VARG(9)
, ACON(9) , BCON(9)
, DT , G
, RE , MACH
, PAR , ROR
, TIREPH , TIRES
, TPH (20), DIS(2G)
, TLSI (20), DIF(12G)
, LIFT , DRAG
, FP , FPOLD
, QV , FVAC
, LIFTA , DBR
, ULFT
   GENFF   ,Tal(9)
,CaTI(9,9)
,DPSa
,PA
,CSR
,Tap
,DIP(20)
,DIS1(20)
,TAX
,FPD
,LIFTV
,DRAGV
,DB
   SVAR(16)
DCON(9)
Q
RO
VNR
TOS
  , NDC( 20)
, DTP
, QS
, CS
, SUMSQ
, TR( 9)
   ,07P
,18U(2G)
,4ACHV
   TIME
     *TIMPR
*AE
*QR
TBURN
  ORAGR
ISP
ULFTR
XHCGM
DELTAE
XJ
  DRAGA
ISPF
ULFTA
COBAE
,SIO
   SENF
SENF
SENF
SENF
SENF
SENF
SENF
  , XKG
   , XKP
   , XK3
, XK3D
, XK3V
, XK3V
, XK3O
, XK3M
, DPDY(3,8)
MACHE,
  XK20
XK20
XK2V
XK2P
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   GENF
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  GENF
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GENF
GENF
FRAT
GENF
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STATE3D
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STATE3D
  MACH,
   ,SYY(10)
,SAYBP(15)
,OCOFO2
   , YOC 93
   SINGAM
DCORHO
   STATE3D
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STATE3D
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PDM
VDD
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,00G
,00R
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,600
42.
43.
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  STATE30
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   ,SDA
,PHI
,XLAMP(9)
,ZCSM
,CMOM
   ,PDA
,SINPHI
,CDO
,CLGM
,FKM
COMMON/ARCDAT/
*SREF ,EJ
*IATM ,IMON
*XLMAX ,HDM
*MAEB ,MAEB
   COMMON/ARCDAT/
*SREF EJ XI
*IATM INDOE JA
*XLMAX HDMAX GR
*AAEB MAEC MA
*MI MISP MX
*MOB XCGR ZC
*DREF MCDD R
* FRATE ARCD(9)
BIAENSION ARCDA(9)
EQUIVALENCE(SREF, ARCDA)
EQUIVALENCE(SREF, ARCDA)
ASSIGN 20 TO 160
GO TO 4
ENTRY EL2000
ASSIGN 40 TO 160
GO TO 5
ENTRY EL2000
ASSIGN 50 TO 160
ASSIGN 50 TO 160
   XISP
JAER
GNOOT
MAED
MXCG
ZCGR
   DTNC
DMAX
PHMAX
HAEF
HUDA
ZE
REMAX
   , DTPI
, GMAX
, MAEA
, MAEG
, MUOB
, XT
  TAULT
JPRO
,ALFMAX
,MAEE
,MZCS
,XE
   , ĈĂULT
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EL2
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77. C
78. C
  60 TO 5
  ETS
ETS
ETS
   # RAC = ZCGM+COD - XCGM+SID

HAC = ZCGM+SID - XCGM+COD

    XEMXCG = XE - XCG
    ZEMZCG = ZE - ZCG
    FAC = XEMXCG+SID - ZEMZCG+COD
    SAC = XEMXCG+SID - ZEMZCG+SID
    XJI = 1.- XJ
    GO TO IGO

20    XK2V = XJV+XMCG - XJI+XMCGV
    XK2R = XJR+XMCG - XJI+XMCGR
    XK2M = RAC+T - XJI+XMCGM
    XK2T = FAC
    XK2T = FAC
    XK2D = T*(XEMXCG+COD + ZEMZCG+SID)
    XK2A = -XJI+XMCGA

50    XK2 = FAC+T - XJI+XMCG
  EL2
EL2
  812
883
8845
8867
8890
99123
9945
996
  RETURN
END
```

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## SUBRØUT I NE ENVPRM

#### Subroutine ENVPRM

#### Entry Points. ENVPRI

#### Purpose

ENVPRM computes steepest-descent-solution trajectory environmental parameters that affect vehicle weight. It is used with SSSP sizing synthesis problems only.

#### Description

Subroutine ENVPRM is called by MODELA at every compute interval of the steepest descent solution trajectory on SSSP type sizing problems.

On branched trajectories having an atmospheric entry portion, it computes maximum dynamic pressure times angle of attack product  $(q\alpha)$ , threshold heat load, and maximum total load factor.

During boost, it computes maximum dynamic pressure and also saves the velocity, altitude flight path angle, time, and Mach number at the point where the maximum dynamic pressure occurs.

Entry point ENVPRI initializes the threshold heat load to zero at the beginning of the trajectory.

| FORTRAM     | MATH   | COD     | E DESCRIPTION                                   |          | STORAG               |      |                                                                                                             |                                      | USAGE                                                                                            |
|-------------|--------|---------|-------------------------------------------------|----------|----------------------|------|-------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------|
| SYMBOL      | SYMBOL | 000     | 2 DESCRIPTION                                   |          | BLOCK                | LOC  | SUBR                                                                                                        | CODE                                 | VAR                                                                                              |
| DRAG        | В      | 1       | Aerodynamic drag                                | (LBS)    | /GENF /(             | 491) | ACCEL<br>BL5<br>BL7<br>BL8<br>ENVPRF<br>FN3<br>OUT<br>PROPB<br>PROPIA<br>SDER3<br>VT                        | I<br>I<br>D                          | DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG                                     |
| PAVO        | ý      | I       | State vector derivatives in steepest descent    | no du le | /STATE3/(            | 15)  | ADICBS<br>ADICBS<br>ADICBS<br>ADICBS<br>DEFS<br>ENVPR<br>PDBCIN<br>REUS<br>RKTASA<br>SOTES<br>STES<br>YREFS | RIACITION                            | DVAR<br>DVAR<br>DVAR<br>VD<br>VT<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR |
| HT1<br>IARC |        | IJ<br>I | Cyrrent heat load above threshold<br>Arc number |          | /ENVPRM/(* /XCODES/( |      | ENVPRM ADJUST ADJUST ASTIS BNTG ENVPRM FNTG GETELA PROPB PROPB PROPIN STAU STAU STAU STRIOSZ                | W<br>IIII<br>M<br>IIII<br>M<br>IIIII | HT I CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC                                                         |
| INTB        |        | i       | Branching and intermediate constraint flag      |          | /XCODES/(            |      | ADIC3A<br>BMTG<br>ENVPRM<br>FNTG<br>SDINP<br>TEST<br>TRAN3<br>TRTOSZ                                        | I                                    | INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB                                             |
| LIFT        | L      | I       | Aerodynamic lift                                | (LBS)    | /GENF /(             |      | ACCEL<br>BL4<br>BL5<br>BL6<br>ENVPRM<br>FH3<br>OUT<br>PROPB<br>PROPIN                                       | I<br>I<br>I<br>I<br>I<br>I<br>O      | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT                                     |
| MACH        | m      | 1       | Asch number                                     |          | /GENF /( *           | 307) |                                                                                                             | I i                                  | MACH<br>MACH<br>MACH<br>MACH                                                                     |

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| FORTRAN    | HTAM   | CODE                         | DECODIBITION                                                       | _      |                  | ORAG         |      | SUBROUT                                                                                      | INE                                       | USAGI                                                                |
|------------|--------|------------------------------|--------------------------------------------------------------------|--------|------------------|--------------|------|----------------------------------------------------------------------------------------------|-------------------------------------------|----------------------------------------------------------------------|
| SYMBOL     | SYMBOL | CODE                         | DESCRIPTION                                                        |        | BLOCK            |              | LOC  | SUBR                                                                                         | 300                                       | VAR                                                                  |
| NSAB       |        | 1 Number of a                | rcs on first branch                                                |        | /XCODE           | s/c          | 134) | ADICB3<br>BNTG<br>ENVPRM<br>FNTG<br>SDIMP<br>TEST<br>TRAM3<br>TRTOSZ                         | I<br>I<br>M<br>I<br>I                     | NS AB<br>NS AB<br>NS AB<br>NS AB<br>NS AB<br>NS AB<br>NS AB<br>NS AB |
| NSB        |        | I Number of a<br>Intermediat | rcs prior to branch point or<br>e constraimt                       |        | /XCOBE           | \$/ <b>{</b> | 133) | TEST                                                                                         | I<br>I<br>I<br>I<br>I<br>I                | NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB                 |
| ۵          | q      | I Dynamic pre                | ssure                                                              | (PSF)  | /GENF            | /€           | 303) | DUT<br>PDBC                                                                                  | #<br>I<br>I                               | 0<br>0<br>0<br>0                                                     |
| QALF       |        | W Current max product        | lmum dynamic pressure - angle-of-                                  | attack | /EN¥PR           | M/(+         | )    | ENVPRM                                                                                       | ¥                                         | BALF                                                                 |
| QL1m       |        | M Saved value                | of maximum dynamic pressure.                                       |        | /51ZIN           | G/(          | 264) | ENVPRM                                                                                       | Ħ                                         | OLIM                                                                 |
| H A U      |        | I Radian to a                | ngle conversion, 57 29577951                                       |        | /BATA            | <i>/</i> (   | 2)   | FNTG<br>GUIJA<br>MODELA<br>MTXJA<br>GUT<br>PADS1                                             | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>0 | DEG<br>RADD<br>RADD<br>RADD<br>RADD<br>RADD<br>RADD<br>RADD<br>RAD   |
| S <b>Q</b> |        |                              | data array (37,5) that contains<br>a and some injection quantities | the    | /5121 <b>n</b> i | G/(          | 74)  | PRITVA<br>RANGE<br>REUS<br>SIZEMR<br>SIZIM<br>STANDUT<br>TAMPAR<br>TAMPER<br>THRUSZ<br>VEHDF | MIIIIMOOMMIMOMMA                          |                                                                      |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE,                  | DESCRIPTION                                                                                      | STORAG<br>RUDCK        | E SUBROUTINE USAG<br>LOC SUBR CODE VAR                                                                                                                                                                                                                                                                                                                              |
|-------------------|----------------|------------------------|--------------------------------------------------------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SQRT              |                | F Square               | root function                                                                                    | /SQRT /{\$             | PAYOZ F SORT PAYOZ F SORT OCTOE F SORT DERSA F SORT ENVPR F SORT HUNT F SORT MODELA F SORT MODELA F SORT OPWELL F SORT PATOS F SORT PATOS F SORT PATOS F SORT POBC F SORT POBC F SORT STORE F SORT STORE F SORT STORE F SORT                                                                                                                                        |
| S¥                |                |                        | esis array (28) containing staging<br>ers and misc flags<br>———————————————————————————————————— | /S121NG/(              | ## 14 PER PART   SY                                                                                                                                                                                                                                                                                                                                                 |
| THRESH<br>TIME    | t              | W Thresho<br>I Time (e | ld heating rate<br>lapsed)                                                                       | /ENVPRM/(≠<br>/GENF /( | O ENVPRM W THRESE  493) ADICBS O TIME ASTS I TIME BATE HIME CONS I TIME OTFS I TIME ENVPRM I TIME EQUAS I TIME FATE HIME FATE HIME OUT I TIME PODE I TIME PROPIN I TIME REUS HIME REUS HIME REUS HIME RETASA M TI E |
| TLOFAC            |                | 8 Current              | waximum total load factor                                                                        | /ENVPRM/(+             | ) ENVPRM W TLOFAC                                                                                                                                                                                                                                                                                                                                                   |

| FORTRAN<br>SYMBOL | MATH<br>SYMBOL | CODE         | DESCRIPTION |             | S TO<br>BLOCK | RASE | ıc  | SUBROU<br>SUBR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | TINE                                    | USAGE                                  |
|-------------------|----------------|--------------|-------------|-------------|---------------|------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------|
| 3111001           | STREEL         | <del>,</del> |             | <del></del> | DLUGK         |      | ,,, | 3000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CUUL                                    |                                        |
| fav.              | v              | 1 Relative w | Plosity     | (FT/SEC)    | /STATE3       | /K   | 1)  | ACCICESTA ADJUSTS ACCICESTA ADJUSTS ACCICESTA | #OITIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII | ###################################### |
| u                 | W              | I Weight     |             | (LBS)       | /GENF         | /( 4 | 12) | BL5<br>ENVPRM<br>EQUA3<br>FH3<br>GUT<br>POBC<br>REU3<br>TRTOSZ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1<br>I<br>I<br>I                        | 년<br>년<br>년                            |

ENVPRM

| 1.<br>2.<br>3.  | C | H03                        |                                           | IRONMENTAL  <br>8, ISPO, IDV                                        |                          | HAT AFFECT                 | WE16RT                                  | ENVPRO<br>ENVPRO<br>SIZIN |
|-----------------|---|----------------------------|-------------------------------------------|---------------------------------------------------------------------|--------------------------|----------------------------|-----------------------------------------|---------------------------|
| 4.              |   | REAL MUB<br>COMMON /       | SIZING/                                   | D, 1300, 100                                                        | LC, 1110, 110            |                            |                                         | SIZIN                     |
| 5.              | C | ARG                        | SF 11 ST71                                | NG PARAMERERS                                                       | 5                        |                            |                                         | SIZIN                     |
| 6.              |   | *TZ,                       | VV(3),                                    | 0P(14), E                                                           | ion, PZ(5                | ), VO,                     | S₩(20),                                 | , SIZINI                  |
| 7.              | _ | *5V(28),                   | 50(37,5),                                 | QP(14), EL<br>SE(11), TI<br>PARAMERERS                              | LAT, TEN                 | 6,                         |                                         | SIZIN                     |
| 8.              | E | PHAS                       | E I SIZING                                | PARAMERERS                                                          | 170 701                  |                            | TWRAT2,                                 | SIZIN                     |
| 9.              |   | ≠₩80,<br>+BK1,             | WLOO,<br>BK2,                             | DWEB, DI                                                            | NEO, TOLI<br>C4, ISI     | JT, WPB,<br>Ze, Traf       | LG, THRATO,                             | SIZIN                     |
| i.              |   | #0K1,                      |                                           |                                                                     |                          | 6, IPAS                    | S, IPSMAX,                              | SIZIN                     |
| 2.              |   | +OK1.<br>≠AEXIT.           | OK2,<br>TVACO,                            |                                                                     |                          | - 1568                     | _ 15P8.                                 | SIZIN                     |
| 3.              |   | *XPL,                      |                                           | NNB. W                                                              | O, WEB                   | is, who                    | ' WLO,'                                 | SIZIN                     |
| 4.              |   | <b>+BVO</b> ,              | DVB.<br>BECÓ,                             | ี้ คีบ์ธ , อา<br>ธราธ , อา                                          | 0, WEB                   | EG. MPD                    | •                                       | SIZIN                     |
| .5              |   | *UVU<br>*,JTÝP<br>* SVDPŠD | BECO .<br>Sydcón                          | BSTG OF                                                             | PSTG , ISZD              | MONTILL                    | ,                                       | SIZIN                     |
| 6-              |   | * 5VUPSU                   | CUESADORN                                 | THUNI ,II                                                           | 16218 1250               | (19)                       |                                         | UH<br>SENF                |
| 7.              |   | *0#6(20)                   | DMBP(20                                   |                                                                     |                          |                            | MUCCOCI                                 | GENF                      |
| 9.              |   | +A(9,9)                    | ACBM(9)                                   | ,2),VARQ(9)                                                         | ,TOL(9)<br>,COTI(9,9)    | DCON(9)                    | DIP                                     | OT NE                     |
| 0.              |   | +BTS                       |                                           |                                                                     |                          |                            |                                         | CENE                      |
| 11.             |   | ≠Ř                         |                                           | HACH                                                                | PA                       | RO                         |                                         | GENF                      |
| 2.              |   | ≠VNU                       | , PAR                                     | ROR                                                                 | CSR                      | , VNR                      | ,SUMSO ,                                | GENF                      |
| 3.              |   | *5V50                      | TIMEPH                                    | ,ROR<br>,TIMES<br>20),DIS(20)<br>20),DIP1(20)                       | ,CSR<br>,TOP<br>,DIP(20) | YNR<br>TOS<br>T<br>TIME    | SUMSO (                                 | GENF                      |
| 4.              |   | *TST(20)                   | TPH (                                     | 20),015(20)                                                         | ,017(20)                 | ,l.,_                      | OMP                                     | SENF                      |
| 5.              |   | *TLP1(20)<br>*TIMPR        | , i L51 (                                 | DRAG,                                                               | ,DIS1(20)                | TBURN                      | TBU(20)                                 |                           |
| 6.<br>7.        |   | +11MPK<br>∓åE              | ,LIFT<br>,FP                              | , coal n                                                            | FPD                      | MACHR                      | , MACHY                                 | GENF                      |
| 8.              |   | *08                        | , ov                                      | FVAC                                                                | LIFTV                    |                            |                                         | GENF                      |
| 9.              |   | *LIFTR                     | LIFTA                                     |                                                                     |                          | DRAGE                      | DRAGA<br>ISPF                           | GENF                      |
| Ö.              |   |                            | LIFTE                                     | ,08R_                                                               | nn ·                     | ,ISP                       | ISPF                                    | SENF                      |
| 1.              |   | *                          |                                           |                                                                     |                          |                            | . ULTIA .                               | CCNE                      |
| 2.              |   | <b>÷XRC6</b>               | , XMCGV                                   | AWCCE                                                               | IPLEA                    | Z MI: SA                   | _CBDAE .                                | , GENF                    |
| 3.              |   | *CULFT                     | , CT                                      | LALPED                                                              | CDE                      | HET THE                    | ,\$1D ,                                 | , GENF                    |
| 4.              |   | *C0D                       | , SIDAE                                   | ,106                                                                | 206                      | ,xJ                        |                                         | GENF                      |
| 5-              |   | COMMON /                   | ~                                         |                                                                     |                          | ***                        | ~~n                                     | GENF                      |
| 6.              |   | *XJV                       |                                           | , вн                                                                | , GAMMAD                 | ,xk6                       | ,XKP ,                                  | GENF<br>GENF              |
| 7.<br>8.        |   | +FRATED<br>+P1             |                                           | , P3                                                                | ,XK1                     | ,XK2_                      | , XK3 ,                                 | GENF                      |
| 9.              |   | ¥XX1T                      |                                           |                                                                     | ',XK1D                   | XXZD                       |                                         | CENE                      |
| 0.              |   | +XXIA                      |                                           |                                                                     |                          | 1820                       |                                         | CCHE                      |
| 11.             |   | ¥XK16                      | . 1625                                    | 18.54                                                               | XKIV                     | XK2P                       | XXXP .                                  | CERE                      |
| 2               |   | *XK1R                      |                                           |                                                                     |                          | , XK2P<br>, XK20<br>, XK2M | *****                                   | GENF                      |
| i3.             |   | *XKIU                      | , xx20<br>, pe                            | , xk3U                                                              | , IKIM                   | XK2A                       | ,XK3H ,                                 | GENE                      |
| 4.              |   | *PV                        | PG                                        | , xk3u<br>PP<br>LIFTA LIF<br>LIFTY IRATI<br>TSTICIO<br>PHI),(TLSI,T | PR<br>In                 | .PU                        | _UFUY(J.8)                              | GENF                      |
| 5.              |   | HEAL LI                    | FTR , LIFT                                | LIFTA, LIF                                                          | Я,                       | MACH,                      | MÁCHR,                                  | GENF                      |
| 16.             |   | * 15r, 15                  | rr mache,<br>M faultici                   | LIFIY , JHAII                                                       | מב                       |                            |                                         | FRAT<br>GENF              |
| 8.              |   | DIMENSIO                   | N I RILLUI                                | , 15 11 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1                            | 2713                     |                            |                                         | SENF                      |
| 9.              |   | COMMON /                   | XCODES/                                   | (017,(124,)                                                         | 31 # 7                   |                            |                                         | ACOUR                     |
| o.              |   | #ITQ (                     | 9),ICOR (                                 | 20),171                                                             | , INTB                   | .161B(26.2                 | ), JPH (20,2),                          | . XCOBE                   |
| 1.              |   |                            |                                           | NCNST                                                               | N58                      |                            |                                         | XCDDE                     |
| 2.              |   | *120P                      | 1000                                      | ,IFAW                                                               | LEAR                     | IFK                        |                                         | XCODE                     |
| 3.              |   | ATOL CH                    |                                           | , ISPH                                                              | , 15\$T                  |                            | INTERI                                  | <b>XCOBE</b>              |
| 4 -             |   | +ITCT                      | TTER                                      |                                                                     | , JK<br>, KST            | , I ARC<br>, NAD           |                                         | XCODE                     |
| <u>5</u> -      |   | *KOP                       | EPNI                                      |                                                                     | , K5 î                   | ,NAD                       |                                         | , XCDDE                   |
| 6.              |   | *NCN                       |                                           | , NED<br>, IPRINT                                                   | , NOP<br>, ISTN          | ,nrn                       | , ISTNB                                 | , XCODE                   |
| 7.<br>8.        |   | ≠NST<br>≠IPHNB             | IPST<br>IBLK1                             | , IBLK2                                                             | LISIN                    | ,ISTPP                     | - TOLIND .                              | , XCODE<br>XCODE          |
| 9.              |   | *1788<br>*1508<br>*NCTIN   | 'NB'                                      | , IBLK2<br>LB<br>LAB(8), JPRP,.                                     | , 13.UF                  | HPHP                       | , Mane ,                                | XCODE                     |
| ó               |   | +NCTIH                     | NEOF 1                                    | LAB( B ) IPRP                                                       | IGÍI MTT NPI             | V(20), 3P1 II              | PŽ.JP3                                  | XCODE                     |
| ĭ               |   | COMMON/B                   |                                           |                                                                     |                          |                            |                                         | DATA                      |
| Ž.              |   |                            |                                           | , RDI                                                               | , S.C.                   | ,UAF                       | ,TMPF                                   | DATA                      |
| 3.              |   | *FTNM                      | , KAB<br>CAR<br>NCÉ (SE(6)                | ,J0P1                                                               | ,J072                    | ,J0P3                      | ,30P4 <sup>1</sup>                      | DATA                      |
| 4.              |   | EQUIVALE                   | NCE (SE(6)                                | ,QLIA)                                                              | -                        |                            | -                                       | ENVPR                     |
|                 |   | COMMON/S                   | TATE3/                                    |                                                                     |                          | 1154.55                    | F. 11 11 2 2 2 2                        | STATE                     |
| 6.              |   | +VAR(14)                   | , DVAR (                                  | 14), VARL (99<br>9), VDS (20,9<br>, SINRHO<br>, OMEGAZ              | ) , DVAHL( 49 )          | , 10(4)                    | ,54Y(10)<br>,54YBP(15)                  | , STATE<br>, STATE        |
|                 |   | *XL(9,9)<br>*SINPSI        | ,Y8F(20,                                  | 73,485 (20,9                                                        | ,, LUS 6 A PI            | ,DiNORH                    | ,584BL(12)                              | C T . T !!                |
| 7.              |   | *51NP\$1                   | 9100564                                   | ,510KHU                                                             | , сознио                 | ,осокио                    | ,0coR02                                 | . STATE<br>STATE          |
| 8.              |   | *24PA (                    | , GDV                                     | , RDV                                                               | MDY                      | ,POV                       | ,opy ,                                  | CTATE                     |
| 8.              |   |                            |                                           |                                                                     | 1221                     | , 01                       | , , , , , , , , , , , , , , , , , , , , |                           |
| 8-<br>9-        |   |                            | , voe                                     |                                                                     |                          |                            | 006                                     | STATE                     |
| 8 -<br>9 -<br>0 |   | *UDV                       | , VDG<br>, VDR                            | ,606                                                                | ,RD6                     | ,706<br>PN9                | ,006<br>,006                            | CTATE                     |
| 7.8.9.0         |   |                            | RGV                                       | , GDR<br>, GDR                                                      | , RD6<br>, MDR<br>, MDR  | ,PDR<br>.PDR               | ,006<br>,008<br>,vop                    | , STATE                   |
| 8-<br>9-<br>10  |   | +UB¥<br>+UBG               | , VOG<br>, VDR<br>, VDM<br>, PDP<br>, UDO |                                                                     |                          | ,PDR<br>.PDR               | ,006<br>,008                            | STATE:                    |

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```
REAL MDM , MDV , MDR
COMMON/STATE3/
+SIN2R0 , COS2R0 , COS2GM
IF(INTB EQ 2) SO TO 100
I MAXIMUM DYNAMIC PRESSURE

10 IF( IARC.GE IFIX(SQ(1,3))) RETURN
IF( Q.LE QLIM ) RÉTURN
QLIM = Q
SQ(5,1) = TIME
SQ(6,1) = VAR(3)
SQ(7,1) = VAR(1)
SQ(8,1) = VAR(2)*RAD
SQ(9,1) = MACH
RETURN
II BRANCH TRAJECTORY TEST
   STATE30
STATE30
STATE30
ENVPRM
ENVPRM
   76
77
78.
79
   100-
  ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
    81
82
83
84
85
86
87
88
89
  ENVPRM 120 200
    91
92
93
94.
                             100 IF(IARC LE NSB) 60 TO 10
IF(IF1X(SQ(1,3)) LE.NSB+NSAB) 60 TO 120
IF(IARC 6T.NSB AND IARC.LE.NSB+NSAB) 60 TO 200
  ENVPRM
ENVPRM
                             120 IF(IARC GT NSB+NSAB) GO TO 200
RETURN
111 ENTRY TRAJECTORY PAI
    95
96
97.
  ENVPRA
  ENVPRM
ENVPRM
   ENTRY TRAJECTORY PARAMETERS Q*SLPHA AND HEAT RATE
                     ¢
                             III ENTRY TRAJECTORY PARAMETERS OF CONTINUE

QALF = Q*APHR

IF(QALF GT.SV(1) ) SV(1) = QALF

TLOFAC = SQRT(LIFT+LIFT + DRAG*DRAG$) / W

IF(TLOFAC GT SV(27)) SV(27)= TLOFAC

IIIA THRESHOLD HEAT LOAD AND TIME

IF(THRESH ST 0) GO TO 220

IF(DVAR(8).LT SQ(30,2)) RETURN

THRESH = TIME

HT1 = VAR(8)

RETURN
   ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
98.
99
100.
101
102
103
104
105.
106
107
                      C
  220~
  ENVPRM
                            NELUHN
220 IF(DVAR(8) LT SQ(30,2)) RETURN
SQ(30,3)= TIME -THRESH
SQ(30,4) = VAR(8) - HT1
RETURN
ENTRY ENVPRI
THRESH =0.
RETURN
END
109
110
111
112.
113
114
115.
   ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
ENVPRM
```

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## SUBRØUT I NE EQUA3

#### Subroutine EQUA3

### Entry Point. EQUA

#### Purpose

Subroutine EQUA3 computes functions of state only during the integration of the forward steepest descent trajectory and also during the adjoint integration.

#### Description

The basic logic of this subroutine depends first of all on whether a vacuum simulation, IATM=3, is desired and second whether a forward or adjoint integration is in progress. Secondary logic accounts for the types of table look-ups that are required according to simulation options.

| ORTHAN  | HTAM                 | CODE | DESCRIPTION                            |          | STORA     | 3E   | SUBROUTIN                                                                                  | E USAGE                                                                                          |
|---------|----------------------|------|----------------------------------------|----------|-----------|------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 2 AWROF | 24WBOF               | 0001 | DESCRIPTION                            |          | BLULK     | LOC  | SUBH COD                                                                                   | E VAR                                                                                            |
| ALT     | h                    | i    | Altitude                               |          | /STATE3/( | 3)   | EQUAS I<br>OUT I<br>POBC I                                                                 | ALT<br>ALT<br>ALT                                                                                |
| COO     | c <sub>Do</sub>      | I    | Drag coefficient at $\alpha \approx 0$ |          | /AEC03 /( | 34)  | BEROCO I<br>EQUAS I                                                                        | CDO<br>CDO                                                                                       |
| CDOM    | aC <sub>Do</sub> ∕am | I    | See symbol                             |          | /AEC03 /( | 35)  | BEROCO I<br>EQUAS I                                                                        | CDOM<br>CDOM                                                                                     |
| CLA     | CLa                  | M    | Lift coefficient slope                 |          | /AEC03 /( | 50)  | BEROCO M<br>EQUAS M<br>VT I                                                                | CLA<br>CLA<br>CLA                                                                                |
| CLAM    | 9C <sup>F</sup> ~\9W | M    | See symbol                             |          | /AEC03 /( | 48)  | BEROCO I<br>EQUAS M                                                                        | CLAM<br>CLAM                                                                                     |
| CLO     | c <sup>ro</sup>      | I    | Lift coefficient at $\alpha = 0$       |          | /AEC03 /( | 36)  | BEROCO I<br>EQUA3 I                                                                        | CL0                                                                                              |
| CLOM    | aC <sup>LO</sup> ∕am | I    | See symbol                             |          | /AEC03 /( | 40)  | BEROCO I<br>EQUAS I                                                                        | CLOM                                                                                             |
| CMA     | C <sup>M™</sup>      | M    | Moment coefficient slope               |          | /AEC03 /( | 42)  | EQUAS M<br>MAMECO I<br>VT I                                                                | CMA<br>CMA<br>CMA                                                                                |
| CMAM    | 9C,,,∧9M             | M    | See symbol                             |          | /AEC03 /( | 43)  | EQUAS M<br>MAMECO I                                                                        | CMAM<br>CMAM                                                                                     |
| CMO     | c <sup>M0</sup>      | I    | Moment coefficient at $\alpha = 0$     |          | /AEC03 /( | 45)  | EQUA3 I<br>MAMECO I                                                                        | CMO<br>CMO                                                                                       |
| CMOM    | ac <sub>M</sub> o∕aw | 1    | See symbol                             |          | /AEC03 /( | 46)  | EQUAS I                                                                                    | CMOM<br>CMOM                                                                                     |
| COSGAM  | cos(7)               | 0    | See symbol                             |          | /STATE3/( | 687) | ACCEL I BL4 I BLB I DER3A I EQUAS O MODELA I MODELB I OUT I POBC I POYSA I                 | COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM |
| COSPSI  | c o s( <b>ψ</b> )    |      | See sy≋boł                             |          | /STATE3/( | 705) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>POBC I<br>PDY3A I | COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI                     |
| COSRHO  | cos(ρ)               | M    | See symbol                             |          | /STATE3/( | 707) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 M<br>MODELA I<br>MODELB I<br>OUT I<br>POY3A I  | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO |
| CS      | a                    | M    | Speed of sound                         | (FT/SEC) | /GENF /(  | 310) | EQUA3 M                                                                                    | CS<br>CS                                                                                         |
| CSR     |                      | I    | Deriv Of speed of sound mrt alt.       |          | /GENF /(  | 314) | EQUA3 I                                                                                    | CSR                                                                                              |

| FORTRAN | MAIH           | CODE | DESCRIPTION                          |             | STOHAG    |      | SUBROU                                                               |                                 |                                                      |
|---------|----------------|------|--------------------------------------|-------------|-----------|------|----------------------------------------------------------------------|---------------------------------|------------------------------------------------------|
| SYMBOL  | SYMBOL         |      | DESCRIPTION                          |             | BLJLK     | LOL  | SUBR                                                                 | CODE                            | NAR                                                  |
| 08      | D <sub>b</sub> | I    | Base drag                            | (L8S)       | /GENF /(  | 537) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>OUT<br>SDER3    | I<br>I<br>I<br>I<br>I<br>I<br>I | 98<br>98<br>98<br>98<br>98<br>98<br>98<br>98<br>98   |
| DBR     |                | I    | Partial of base drag wrt altitude    |             | /GENF /(  | 536) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>VT              | I<br>I<br>I<br>I<br>I           | OBR<br>OBR<br>OBR<br>OBR<br>OBR<br>OBR<br>OBR        |
| DZM     | P <sub>a</sub> | M    | Atmospheric pressure                 | (PSF)       | /GENF /(  | 308) | EQUA3<br>FH2<br>IMPUL<br>OUT<br>POBC<br>SDER3                        | I<br>I<br>I                     | DZM<br>PA<br>PA<br>PA<br>PA<br>PA                    |
| ER      | E <sub>R</sub> | I    | Earth radius.                        | · (FT)      | /GLOBAL/( | 2)   | COORDS<br>CRASH<br>EQUA3<br>GEINP<br>PADS1<br>PDBC<br>SOMG<br>TRTOSZ | I<br>I<br>I<br>I<br>I           | ER<br>REM<br>ER<br>ER<br>ER<br>ER<br>ER              |
| FK      | k              | I    | Induced drag coefficient             |             | /AEC03 /( | 37)  | BERDCO<br>EQUAS                                                      | _                               | FK<br>FK                                             |
| FKM     | ak/am          | I    | See symbol                           |             | /AEC03 /( | 47)  | BEROCO<br>EQUAS                                                      | I                               | FKM<br>FKM                                           |
| FRATE   |                | I    | Input rated vacuum thrust per engine | (LBS)       | /ARCDAT/( | 42)  | EQUAS<br>FXDAT<br>PROPB<br>PROPIN<br>SIZIN                           | I<br>I<br>I                     | FRATE<br>FRATE<br>FRATE<br>FRATE<br>FRATE            |
| FVAC    |                | M    | Total vacuum thrust [rocket]         | (ŁB\$)      | /GENF /(  | 528) | ACCEL<br>EQUA3<br>FH2<br>IMPUL<br>PROPB<br>PROPIN<br>SDER3           | I<br>M<br>M                     | FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC |
| G       | g              | M    | Sravitational attraction             | (FT/SEC**2) | /GENF /(  | 301) | BL7<br>BL8                                                           | I<br>I<br>M<br>M                | 9999999999                                           |
| GAM     | 7              | 1    | Relative flight path angle           | (GAR)       | /STATE3/( | 2)   | EQUAS<br>GUISA<br>OUT                                                | I<br>I<br>I                     | GAM<br>GAM<br>GAM                                    |
| GH      |                | 0    | Partial of gravity wet altitude      |             | /GENF /(  | 563) | BL7<br>BL8<br>EQUA3<br>PDY3A                                         | I<br>I<br>O<br>I                | GH<br>GH<br>GH<br>DGDH                               |

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| FORTRAN<br>Symbol | MATH<br>Symbol | L00E               | DESCRIPTION                                                                | S T OR A<br>BLULK | GF<br>LOC | <u> 5 ปลิลจับ</u><br>5 ปลิล                                                                                                                                                                                                                     | TINE USAGI<br>CODE VAR                                       |
|-------------------|----------------|--------------------|----------------------------------------------------------------------------|-------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
|                   |                |                    |                                                                            |                   |           | ,                                                                                                                                                                                                                                               |                                                              |
| GR                | <b>9</b> r     | I Gra              | vitational acceleration at surface of the earth<br>(FT/SEC <sup>2</sup> )  | /GLOBAL/(         | 11        | ACCEL<br>BL5<br>FH3<br>GEINP<br>GEINP<br>DUT<br>PADS1<br>PADS1<br>PEU3<br>SDINP<br>SIZE<br>SIZ1<br>SIZ2<br>SIZ3<br>SIZ3<br>SIZ3<br>SIZ4<br>SIZ4<br>SIZ5<br>SIZ5<br>SIZ6<br>SIZ6<br>SIZ7<br>SIZ7<br>SIZ7<br>SIZ7<br>SIZ7<br>SIZ7<br>SIZ7<br>SIZ7 | I GR<br>GR GR<br>I GG<br>GR GR<br>I GR<br>GR<br>I GR<br>I GR |
| IATM              |                |                    | asphere option flag                                                        | /ARCDAT/(         | 7)        | EQUAS<br>FXDAT<br>OUT<br>PDBC<br>VT                                                                                                                                                                                                             | I IATM<br>I IATM<br>I IATM<br>I IATM<br>I IATM               |
| 1FOB              |                | I Fori             | ward or adjoint integration flag<br>= 1 means forward<br>= 2 means adjoint | /XCODES/(         | 178)      | ACCEL<br>BERDCO<br>BLYNE<br>EQUAS<br>IMPUL<br>SPLYNE<br>TOPM                                                                                                                                                                                    | I IFOB<br>I IFOB<br>I IFOB                                   |
| JAER              |                | I Aero             | odynamic model option flag                                                 | /ARCDAT/(         | 9)        | BEROCO<br>EQUAS<br>GEINP<br>OUT<br>PROPB<br>PROPIN                                                                                                                                                                                              | I JAER<br>I JAER<br>I JAER<br>I JAER                         |
| JPRO              |                | I Pro              | pulsion model option flag                                                  | /ARCDAT/(         | 10)       | EQUA3<br>GEINP<br>IMPUL<br>MODELA<br>PROPB<br>PROPIN                                                                                                                                                                                            | I JPRO                                                       |
| JPRP              |                | I Pro <sub>l</sub> | pulsion flag for different rocket options                                  | /xcobes/(         | 194)      | ACCEL DERSA EQUAS MODELA PDYSA PROPB PROPIN                                                                                                                                                                                                     | I JPRP<br>O JPRP                                             |
| M                 | m              | I Mass             | s                                                                          | /STATE3/(         | 4)        | ACCEL<br>BL4<br>BL8<br>EQUA3<br>OUT<br>SDER3                                                                                                                                                                                                    | I M<br>I M<br>I M<br>I M                                     |
| MACH              | M              | м Мас              | h number                                                                   | /GENF /(          | 307)      | BEROCO<br>ENVPRM<br>EQUA3<br>OUT                                                                                                                                                                                                                |                                                              |
| MACHR             |                | 0 Par              | tial of mach number ørt altitude                                           | /GENF /(          | 524)      | EQUA3<br>PROPB<br>PROPIN<br>VT                                                                                                                                                                                                                  | O MACHR<br>O ZERO<br>O ZERO<br>I MACHR                       |
| MACHV             |                | 0 Par              | tial of mach number ørt velocity                                           | /GENF /(          | 525)      | EQUA3<br>TV                                                                                                                                                                                                                                     | 0 MACHV<br>I MACHV                                           |

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| FORTRAN    | MATH     | COO | DESCRIPT                        | TON                      | STORA     |      | รบหลอบ                                                                                          |                  |                                                              |
|------------|----------|-----|---------------------------------|--------------------------|-----------|------|-------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------|
| SYMBOL     | SYMBOL   | COU | UESCRIPT                        | 1010                     | BLOCK     | LOC  | SUBA                                                                                            |                  |                                                              |
| MAEA       |          | ı   | Curve number                    |                          | /ARCDAT/( | 18)  | EQUA3<br>GEINP<br>PROPB<br>PROPIN                                                               | I<br>I<br>I      | MAEA<br>MAEA<br>MAEA<br>MAEA                                 |
| MAEB       |          | ī   | Curve number                    |                          | /ARCOAT/( | 19)  | EQUA3                                                                                           | I                | MAEB                                                         |
| MAEC       |          | 1   | Curve number                    |                          | /ARCDAT/( | 20)  | EQUA3                                                                                           | 1                | MAEC                                                         |
| MAED       |          | I   | Curve humber                    |                          | /ARCDAT/( | 21)  | EQUA3                                                                                           | I                | MAED                                                         |
| MAEE       |          | 1   | Curve number                    |                          | /ARCDAT/( | 22)  | EQUA3                                                                                           | 1                | MAEE                                                         |
| MAEF       |          | I   | Curve number                    |                          | /ARCDAT/( | 23)  | EQUA3                                                                                           | 1                | MAEF                                                         |
| MAEG       |          | I   | Curve number                    |                          | /ARCDAT/( | 247  | EQUAS                                                                                           | 1                | MAEG                                                         |
| MDB        |          | ĭ   | Curve number - base drag table  |                          | /ARCDAT/( | 31)  | E0UA3                                                                                           | I                | MDB                                                          |
| MTT        |          | I   | Thrust curve number             |                          | /XCODES/( | 196) | EQUA3<br>PROPE<br>PROPIA                                                                        | I<br>M<br>M      | mit<br>Mit<br>Mit                                            |
| MXCG       |          | 1   | Curve number -xcg table         |                          | /ARCDAT/( | 27)  | EQUA3                                                                                           | 1                | MXCG                                                         |
| MZCG       |          | 1   | Curve number- tcg table         |                          | /ARCDAT/( | 28)  | EQUAS                                                                                           | ī                | MZCG                                                         |
| осояно     | ω×COSRHO | M   | See symbol                      |                          | /STATE3/( | 7083 | DERSA<br>EQUAS<br>MODELA<br>MODELA<br>POBC<br>POYSA                                             |                  | 000840<br>000840<br>000840<br>000840<br>000840<br>000840     |
| OCORO2     | OKROOO×w | 0   | See symbol <sup>2</sup>         |                          | /STATE3/( | 709) | DERSA<br>EQUAS<br>MODELA<br>MODELA<br>POYSA                                                     |                  | OCOROZ<br>OCOROZ<br>OCOROZ<br>OCOROZ<br>OCOROZ               |
| om6Z       | Ø        | I   | Earth rotation rate             | (RAD/SEC)                | /GLOBAL/( | 3)   | ADIDSA<br>CRASA<br>DERSA<br>EQUAS<br>MODELA<br>MODELA<br>POSC<br>POSC<br>PDYSA<br>SOINP<br>TOPM | I<br>I<br>I<br>I | OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ |
| PS1        | 4        | 1   | Azswyth                         |                          | /STATE3/( | 5)   | EQUAS<br>GUISA<br>DUT                                                                           | i<br>i           | PSI<br>PSI<br>PSI                                            |
| Q          | q ,      | M   | Dynamic pressure                | (PSF)                    | /GENF /(  | 303) | ENVPRA<br>EQUAS<br>OUT<br>PDBC<br>VT                                                            | ]                | <b>G</b> G G G G                                             |
| QR         |          | ศ   | Partial of dynamic pressure ort | altitude                 | /GENF /(  | 526) | EQUA3<br>VT                                                                                     | rs<br>I          | QR<br>QR                                                     |
| <b>Q</b> 5 |          | Ū   | Product of dynamic pressure and | iaero Ref. Area<br>(LBS) | /GENF /(  | 304) | EQUA3                                                                                           | 0<br>1           | 05<br>05                                                     |
| 0 V        |          | M   | Partial of dynamic pressure wrt | velocity                 | /GENF /(  | 527) | EQUA3<br>TEST<br>VT                                                                             | m<br>I           | δλ<br>64<br>6Λ                                               |
| R          | R        | M   | Radiał distance from earth cent | er to vehicle (FT)       | /GENF /(  | 305) | BL4<br>BL8<br>DER3A<br>EQUA3<br>MODEL6<br>MODEL6<br>POBC<br>POY3A<br>TRTOS2                     | I<br>I<br>I      | 88888888888888888888888888888888888888                       |

30 0ET 72 G 01-46

| FORTRAN<br>Symbol | MATH<br>Symbol   | CODE            | DESCRIPTION              | J                  | STORA<br>BLOCK | GE<br>LOC | SUBROUTII<br>SUBR COI                                                                                                              | VE USAGE                                                                               |
|-------------------|------------------|-----------------|--------------------------|--------------------|----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| RAD               |                  | I Radian to an  | gle conversion, 57.29571 | 951                | /DATA /(       | 2)        | BERDCO I<br>BLGCON I<br>ENVPRM I<br>EQUA3 I<br>FNTG I<br>GUI3A I<br>MODELA I<br>MOTSA I<br>OUT I<br>PADSI D<br>SOINP I<br>TRTOSZ I | G G G G G G G G G G G G G G G G G G G                                                  |
| RHG               | ρ                | I Latitude      |                          |                    | /STATE3/(      | 6)        | EQUA3 I                                                                                                                            | RHO<br>RHO                                                                             |
| RO                | ٩                | 1 Atmospheric   | density                  | (SLUGS/FT**3)      | /GENF /(       | 309)      |                                                                                                                                    | RO<br>RO<br>RO<br>RO<br>RO<br>RO                                                       |
| ROR               |                  | l Deriv. Of de  | ensity wrt alt.          |                    | /GENF /(       | 313)      | BL7 I<br>BL8 I<br>EQUA3 I<br>POBC I<br>PDY3A I                                                                                     | ROR<br>ROR<br>ROR<br>ROR<br>ROR                                                        |
| SINGAM            | sin(7)           | O See symbol    |                          |                    | /STATE3/(      | 688)      | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>POBC I<br>PDY3A I<br>SDER3 I                              | SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM |
| SINPSI            | sin(↓)           | O See symbol    |                          |                    | /STATE3/(      | 704)      | BL4 I<br>BL7 I<br>BL8 I<br>BER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>PDBC I<br>PDY3A I                                         | SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI           |
| S I NR HO         | sin(ρ)           | 0 See symbol    |                          |                    | /STATE3/(      | 706)      | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 D<br>MODELA I<br>MODELB I<br>OUT I<br>PBBC I<br>PDY3A I                                | SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO<br>SINAHO |
| SREF              | S <sub>ref</sub> | I Aerodynamic i | reference area           | (FT <sup>2</sup> ) | /ARCBAT/(      | 1)        | BNTG I<br>EDUAS I<br>FNTG I<br>FXBAT I<br>FXBAT O<br>GEINP M<br>SDINP I<br>SIZIN M<br>THRUST I                                     | ARCDA<br>ARCDA<br>ARCDA<br>IARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>SREF<br>SREF           |

| FORTRAN | MATH              | COO | DESCRIPTION                                           |       | STORA     |       | SUBROUTINE USA                                                                                                                                                                                 |
|---------|-------------------|-----|-------------------------------------------------------|-------|-----------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL            |     | DESCRIPTION                                           |       | BLOCK     | LOC   | SUBR CODE VA                                                                                                                                                                                   |
| T       | T                 | 0   | Thrust                                                | (LBS) | /GENF /(  | 411 } | ACCEL I T BLGCON M T BL4 I T BL6 I T BL6 I T BL2 I T EQUAS O T FH1 I T FH2 I T T FH3 I T T FH4 I T T IMPUL I T IMPUL I T PROPB O T PROPIN O T REUS O T T SOERS I T                             |
| TAIRB   |                   | 1   | Airbreather thrust.                                   | (LBS) | /AIRBRE/( | 1)    | EQUAS I TAIRS                                                                                                                                                                                  |
| TBURN   | t <sub>b</sub>    | 1   | Rocket burn initiation time on forward trajectoryisdl |       | /GENF /(  | 499)  | EQUAS I TBUR<br>MODELA I TBUR<br>PROPB O TBUR<br>PROPIN M TBUR                                                                                                                                 |
| 11 ME   | t                 | 1   | Time (elapsed)                                        |       | /GENF /(  | 493)  | ADICBS D TIME ASTS I TIME BNTG M TIME CONS I TIME COTFS I TIME ENVERM I TIME EQUAS I TIME FNTG M TIME MODELA I TIME OUT I TIME POBC I TIME PROPIN I TIME REUS M TIME RKTRSSA M TI YREFS M TIME |
| TIMEPH  | T p               | 0   | Phase time                                            | (SEC) | /GENF /(  |       | EQUAS O TIMES FNTG M TIMES GETIT I TIMES GUISA I TIMES OUT I TIMES                                                                                                                             |
| TIMES   | *                 | D   | Arc time                                              | (SEC) | /GENF /(  | 319)  | AST3 I TIME:<br>EQUA3 O TIME:<br>FNTG M TIME:<br>GETIT I TIME:<br>OUT I TIME:                                                                                                                  |
| TMULT   | T <sub>#ult</sub> | 1   | Thrust multiplier or number of engines                |       | /ARCDAT/( | 4)    | EQUAS I TMUL<br>FXDAT M TMUL<br>PROPIN I TMUL<br>PROPIN I TMUL<br>SIZIN O TMUL                                                                                                                 |
| TOP     |                   | 1   | Elasped time at phase initiation                      |       | /GENF /(  | 320)  | BNTG M TOP<br>EQUAS I TOP<br>FNTG M TOP                                                                                                                                                        |
| 105     |                   | 1   | Elasped time at and initiation                        |       | /GENF /(  | 321)  | BNTG M TOS<br>EQUAS I TOS<br>FNTG M TOS                                                                                                                                                        |

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| FORTRAN<br>Symbol | MATH<br>Symbol       | CODE           | DESCRIPTION                    | _        | S TO   | RAGE<br>LOC | SUBROU<br>SUBR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | TINE USAGE<br>CODE VAR     |
|-------------------|----------------------|----------------|--------------------------------|----------|--------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| V                 | V                    | î Reistive ve  | locity                         | (FT/SEC) |        |             | ACCIONES ACC | 1                          |
| ы                 | Ш                    | M Weight       |                                | (LBS)    | /GENF  | /( 412)     | YREF3 BL5 ENVPRM EQUAS FH3 OUT POBC REU3 TRTOSZ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1 W<br>I W<br>I W          |
| xcg               | Х <sub>СБ</sub>      | I Center of gr | avity body x station           | (FT)     | /GENF  | /( 558)     | EL2<br>EQUA3<br>VI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | I XCG<br>I XCG<br>I XCG    |
| XCGM              | ∂X <sub>CG</sub> /∂m | O See sy≋bol   |                                |          | /AECO3 | /( 38)      | EL2<br>EQUA3<br>VT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | I XCGM<br>0 XCGM<br>I XCGM |
| ΧJ                | J                    | I Control bles | nd factor                      |          | /GENF  | /( 560)     | EL2<br>EQUA3<br>OUT<br>VT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | I XJ<br>I XJ<br>I XJ       |
| RLX               |                      | 0 Partial of I | piend factor wrt altitude<br>, |          | /SENF  | /( 562)     | EL2<br>EQUA3<br>VT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | I XJR<br>O XJR<br>I XJR    |
| XJV               |                      | O Partial of B | olend factor wrt velocity      |          | /GENF  | /( 561)     | EL2<br>Equas<br>VT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | I XJV                      |
| ZCG               | Z <sub>CG</sub>      | I Center of gr | avity body z station           | (FT)     | /GENF  | /( 559)     | EL2<br>EQUA3<br>VI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | I ZCG<br>I ZCG<br>I ZCG    |
| ZCGM              | ∂Z <sub>CG</sub> /∂m | O See symbol   |                                |          | /AECO3 | /( 391      | EL2<br>EQUA3<br>VT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | I ZCGM<br>O ZCGM<br>I ZCGM |

```
COMPUTES FUNCTIONS OF STATE ONLY
SKIPS STATE PARTIALS ON FORWARD TRAJECTORY (IFOB=1)
COMMON/STATE3/
*VAR(14) , DVAR (14), VARL (99) , DVARL(99) , YO(9) , SVY
*XL(9,9) , YOP(20,9), YOS (20,9), COSGAM , SINGAM , SAV
*SINPSI , COSPSI , SINRRO , COSRHO , OCORHO , OCO
*SVBV (9), OREGA , DREGA2 , MOV , PDV , ODV
*UDV , YOS , GDG , RDG , DV
*UDV , YOS , GDG , RDG , DV
*UDV , YOS , GDG , RDG , R
  EQUAS
COAN
COAN
   0
4.
5.
6.
7.
8.
9.
10.
11.
12.
  COAN
   STATESD
STATESD
STATESD
STATESD
STATESD
STATESD
STATESD
STATESD
STATESD
STATESD
STATESD
  ,544(10)
  ,SAVBP(15) ,
   ,000
,006
,008
,009
,600
   STATE3D
STATE3D
STATE3D
  115...
116...
117...
122...
222...
222...
223...
  STATE 30
   STATESO
EQUVS
EQUVS
EQUVS
   EOUV3
EOUV3
ARCDAT
  COMMON/ARCDAT/
SAFE EJ XI
STATM INDDE JJ
XIATM INDDE JJ
MADB JCGR JC
DREF JACHD JR
JEMENSION ARCDA(40)
EQUIVALENCE(SREF, ARCDA)
COMMON/GLOBAL/
SGR ER JCR
   XISP
JAER
GMOOT
MAED
MXCG
ZCGR
RHOB
   DTPI
GMAX
MAEA
MAEG
MUDB
  TMULT
JPRO
ALFMAX
MAEE
,MZCG
   DTNC
QMAX
PHMAX
MAEF
MUDA
   ARCDAT
ARCDAT
ARCDAT
   ARCDAT
ARCDAT
RETAP
   , ZE
, REMAX
  3123.335.335.412.4434.45.
  , ÖMULT
  ARCBAT
   ARCDAT
GLOBAL
GLOBAL
GLOBAL
  COMMON/GLOBAL/

*GR , ER , OMGZ , XLAMBF , YMURF , LUM

*, JJOP(10) , IFATAL , NARC , NBRAN , NFARC , IO(4)

*, KTABK(20) , ITABK(20) , 516 , MAXTAB

*, GM , PSIRF, IPFLG1 , IPFLG2 , IPFLG4 , INEQFL(20)

*, ITPSO , KSÓL , KGLOBL(8)

*DIMENSIÓN DZM(8) , COMMON /XCODES/

*ITQ (9), ICDR (20), ITI , INTB , JGID(20,2), JPH (20)

*JST (20) , NCNST , NSB , NSAB , NICNB

*JST (20) , ICOR , NSB , NSAB , NICNB
  GLOBAL
GLOBAL
RETAP
EQUAS
   XCODES
XCODES
XCODES
XCODES
   JGID(20,2), JPH (20,2),
NSAB NICNB
IFB IND
IARC ISTART
JPS JS
NAD NCASE NPH NCASE NPH NISTAR ISTAR
ISTART NPH NISTAR ISTAR
  , INTB
, NSB
, IFAR
, ISST
, JK
, KST
, HOP
, ISTO
, ISTO
, ISTO
, ISTO
  ICOP
IPH
ITER
KPST
NEOF
IBLK1
  #JST
#120P
  ZCOODEESSS
XXCOODEESSS
XXCOODEESS
XXCOODEE
XXCOOTA AATAFFFF
DATAFFFF
RENAMED
  *120P
*10PEN
*ITCT
*KOP
*NCN
*NST
*IPHNB
*IFOB
*NCM
  44455555555555666666666666777771
  , RDI
, JOP1
  ,SC
,JOP2
   . UMF
  .THPF
   ,JOP3
   ,J0P4
  JOP2
TOL(9)
COTI(9,9)
COTI(9,9)
COTI(9,9)
COTI(9,9)
COTICO
  NF/

OMSP(20,2), VARD(9),

ACOM(9), BCON(9),

BE, MACH,

PAR, ROR,

TIMEPH, TIMES,

TPH (20), DIS(20),

TLS1 (20), DIP(20),

LIFT ORGAN,

EPP, PPOLD,

OWNER, PPOLD,

OWNER
   ,SVAR(10)
,DCON(9)
   , NDC( 20 )
   DTP
QS
CS
SUMSU
TR(9)
W
OMP
TBU(20)
MACHY
   GENF
GENF
GENF
GENF
GENF
GENF
   RO
VNR
TOS
   TIME, TBURN
  ≠AE
≠QR
   MACHR
   DRAGA
ISPF
ULFTA
CODAE
,SID
   GENF
GENF
GENF
GENF
GENF
GENF
  +LIFTR
   ,LIFTA
   DRAGR
   OBR
ULFT
XMCGR
CALPHA
XCG
   , ISP
, ULFTR
, XMCGM
, DELTAE
, XJ
  XMCGV
CT
SIDAE
GENF /
  *XMCS
  ≠CULFT
≠COD
COMMON
```

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```
767.7901.237.79081.2883.885.889912.3975.678.1002.31005.677.1009.1112.3111.111.13
  , GARRAD
   , XKG
  , XKP
  ,XK3
,XK3D
,XK3P
,XK3P
,XK3D
,XK3M
,DPDY(3,8)
   XK2
XK2D
XK2V
XK2P
XK2P
XK2D
XK2D
  XK1
  XK1
,XK1D
,XK1V
,XK1P
,XK1O
,XK1M
,PR
   PO
  MACH,
   MÁCHR,
  EQUIVALENCE(TLP1,TPH1),(TLS1,TST1)
COMMON/AECD3/
*APHO APHR ALPHA ,VDA ,GDA ,PDA
*SINA COSA PHIO PHID ,PHI SINPHI
*COSPHI GDPH ,PDPH ,XLAMA(9) XLAMP(9) CDO
*CODM ,CLO ,FK ,XCGM ,ZCGM ,CLOM
*CR ,CMA ,CMA ,CMM ,CMO ,CMOM ,FKM
*CLAM ,CL ,CLA
*CL ,CLA
*CL ,CLA
*CD ,CDA ,CDM
*EQUIVALENCE (DZM,PA)
COMMON/AIRBRE/ TAIRB,TAIRBV,TAIRBH,SFC,SFCV,SFCH
EQUIVALENCE (JIN,ILAB(1))
ENTRY EQUA
*IHIS PROGRAM CALC. STATE FUNCTIONS ONLY
*R = ER+ ALT
*SINGAM= SIN(GAM)
*COSGAM= COS(GAM)
**LIMPH = TIME -TOP
*TIMES= TIME -TOS
*G= GR*(ER/ R)**2
*SINPSI= SIN(PSI)
*COSPSI= COS(PSI)
*SINPSI= SIN(PSI)
*COSPSI= COS(PSI)
*SINRHO= SIN(RMO)
*OCRAPE COS(RMD)
*OCRAPE COS(RMD)
*OCRAPE COS(RMD)
*OCRAPE OCOS(RMD)
*OCRAPE OCOS(RMD)
*OCRAPE OCOS(RMD)
*OCORNOE OCOS(R
  COMMON/AECO3/
*APHO AP
*SINA CO:
+COSPHI GO
   *CDOM
*CM
*CLAM
                                   C
   EQUAS
COMM
COMM
PO14
PO14
 114
115
116
117.
   IF(SREF EQ.0) 60 TO 120
IF(IATM-1) 10,20,120
  118.
   10-20-120
119
  CALL ANLATM (ALT, DZM, 1FDB-1)
60 TO 30
  EQUA3
   30-
  20 CALL PAT63(ALT, DZM, IFOB)
 121.
  EQUA3
  30 Q = 5+ R0*V*V
QS= Q*SREF
MACH= V/CS
1F(1F0B EQ.1) 60 TO 40
VSQ = V* V
MACHV= 1./CS
1ACHR= -V/CS/CS+CSR
GH = -2.*G/R
QR=VSQ*R0R/2.
QV= R0*V
  EQUAS
EQUAS
EQUAS
EQUAS
EQUAS
 122.
123.
124.
125.
126.
127.
128.
130.
131.
132.
  40
   EQUAS
EQUAS
EQUAS
  QV= RO*V
   COMN
  11
   DO APPROPRIATE TABLE LOOKUPS FOR AERODYNAMIC MODELS
   40 GO TO (70,80,50) , JAER
   50-
  134
  70-
  EQUA3
  BO.
  50 CONTINUE
CALL SPLYNE(MAEE, MACH, CMA, CMAM)
CALL SPLYNE(MAEE, MACH, CMO, CMOM)
CALL SPLYNE(MAEG, B, XI, XIG)
60 CALL SPLYNE(MACG, W, XCG, XCGW)
CALL SPLYNE(MXCG, W, XCG, XCGW)
CMA: CMA ** CMA ** CMAM
IF(IFOB.EG 1) GO TO TO
CMAM=CMAM** RAB
XIV=XIG** AVE
  EDUAS
EDUAS
EDUAS
EDUAS
EDUAS
EDUAS
EDUAS
EDUAS
 135.
136
137
138.
139
140
141.
142.
143
144.
145.
   70~
   XCGM = XCGH=GR
XCGM = XCGH=GR
XJV=XJQ+GR
```

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```
TO CONTINUE

CALL SPLYNE(MAEA, MACH, CLA, CLAM)

CALL SPLYNE(MAEA, MACH, CLO, CLOM)

CALL SPLYNE(MAEA, MACH, CDO, CDOM)

CALL SPLYNE(MAED, MACH, FK, FKM)

CLA = CLA*RAD

IF(IFOB.EG.1) GO TO 80

CLAM= CLAM#AD
148.
149
150.
151.
152.
153.
154.
  EQUAS
EQUAS
EQUAS
EQUAS
EQUAS
EQUAS
EQUAS
EQUAS
156.
157.
158.
159
160
161
162.
163.
164.
  FIXED
COMM
COMM
COMM
FIXED
FIXED
FIXED
                       80 CONTINUE
                             III-A AIR BREATHER THRUST AND SFC.
IF(JPRO.NE.2) 50 TO 85
CALL BLYNE(V,ALT, TAIRB)
T= TAIRB
GO TO 110
               0000
   FIXED
  FIXED
COMM
COMM
COMM
COMM
COMM
165.
166.
167.
168.
169.
170
                        85 CONTINUE
                                 111-B
   ROCKET
                              TEST FOR ROCKET MODE (THROTTLED OR UNTHROTTLED)

JPRP =1 CONST, 2 UNTHROTTLED , 3 THROTTLED

IF(JPRP-2) 110,100,90
  90-100-110
172.
173.
174
175.
  EQUAS
COMM
COMM
COMM
                        90 IF(JIN.ST.0) 60 TO 110
   110-
                                   III-C IF NO THRUST TABLE GO TO IV, ELSE INTERPOLATE VAC THRST
176
177.
178
179.
180.
181
182.
                    100 IF(ATT.EO.O) 50 TO 109
TPRP = TIME - TBURN
CALL SPLYNE (ATT, TPRP,FVAC,DUM)
FVAC = FVAC+ TRULT
  PHISZ
FRAT
EQUAS
EQUAS
  109
  PH15Z
COMN
COMN
                               60 TO 110
                                IV IF RATED THRUST ZERO SO TO V , ELSE COMPUTE VAC THRUST
183.
184.
185.
186.
                     109 IF(FRATE.LE.O.) GO TO 110 FVAC=FRATE+TAULT
   PHISZ
PHISZ
COMN
COMN
   110-
                                 V INTERPOLATE BASE DRAG
187
188.
189.
190.
  EDUA3
EQUA3
COMN
COMN
                    110 CALL SPLYNE( MDB, ALT, DB, DBR)
RETURN
                                 VI
  VACUUM CALCULATIONS THEN GO TO IIIB
                    VI VACUUM EALCULATIONS T

120 00 130 1=1,8
130 0ZM(1)=0.
CS=1000.
Q=0.
GH=-2.*6/H
QS=0.
HACH=20.
IF(JAER.NE.3) 60 TO 80
140 CALL SPLYNE(MXCG, W, XCG, XCGW)
CALL SPLYNE(MXCG, W, XCG, ZCGW)
IF(IFOB.EQ.1)60 TO 80
XCGM = XCGW+GR
ZCGM = ZCGW+GR
GH = -2.*6/R
GO TO 80
   EQUAS
EQUAS
EQUAS
EQUAS
PHISZ
EQUAS
191.
192.
193.
194.
195.
196.
197.
198
200.
201.
202.
203.
204.
205.
   EQUAS
   EQUAS
EQUAS
EQUAS
EQUAS
EQUAS
EQUAS
PO14
EQUAS
EQUAS
   80
                               60 TO 80
  80
```

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# SUBRØUT INE FH1

#### Subroutine FM1

Entry Points. FH1001, FH1000

#### Purpose

Subroutine FH1 is the governing equation (XK1) associated with the thrust element in the in-plane control vector when the thrust is a constant.

### Description

The solution of the in-plane control using the governing equations is described in Section 9 of Volume I. This subroutine is called from BLGCØN.

| FORTHAN<br>SYMBOL | MAIH   | CORF                             | DECEDIATION                                          |     |        | ORA         |      | SURROL                                                                                                                              | TINE             | USAGE                                        |
|-------------------|--------|----------------------------------|------------------------------------------------------|-----|--------|-------------|------|-------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------------------------|
|                   | SYMBOL | CODE                             | DESCRIPTION                                          |     | BLOC   | Κ           | LOC  | SUER                                                                                                                                | CODE             | VAR                                          |
| СТ                |        | I Constant valu                  | e of vacuum thrust (LB                               | S)  | /GENF  | /(          | 551) | FH1                                                                                                                                 | 1                | CT                                           |
| T                 | Ţ      | 1 Thrust                         | (LB                                                  | \$) | / GENF | <b>∕/</b> € | 411) | ACCEL<br>BLGCOM<br>BL4<br>BL6<br>BL1<br>EL2<br>EQUA3<br>FH1<br>FH2<br>FH3<br>FH4<br>OUT<br>PROPB<br>PROPB<br>PROPB<br>REU3<br>SDER3 |                  | 111111111111111111111111111111111111111      |
| XKI               |        |                                  | vector governing equation value<br>o error in thrust |     | /GENF  | <i>/</i> (  | 572) | BLGCOM<br>FH1<br>FH2<br>FH3<br>FH4<br>MODELA                                                                                        | 0<br>0<br>0<br>0 | XK1<br>XK1<br>XK1<br>XK1<br>XK1<br>XK1       |
| XKIT              |        | 0 Partial of go<br>vector compon | verning equation art state or contro<br>ent          | I   | /GENF  | iĆ<br>-     | 575) | BLGCOM<br>FH1<br>FH2<br>FH3<br>FH4<br>MODELA                                                                                        | 1<br>0<br>0<br>m | XK1T<br>XK1T<br>XK1T<br>XK1T<br>XK1T<br>XK1T |

```
123456789011234567890123456789012
   , WDC( 20 )
, BTP
, BS
, CS
, SUMSD
, TR( 9 )
, MAP
, TBU( 20 )
, MACHY
| (20), b | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 
   DRAGR
ISP
ULFTH
XMCSM
DELTAE
   DRAGA
ISPF
ULFTA
CODAE
SID
   , xKS
  , XKP
   , xk3
, xk3D
, xk3V
, xk3V
, xk3O
, xk3M
, DPDY(3,8)
HACHR,
   , XK2
, XK2D
, XK2V
, XK2P
, XK2D
, XK2M
, PO
  SEMBLE SECTION OF SECT
  MACH,
  (14) VARL (99) DVARL(99)
(0,9) VDS (20,9) COSSGAM
1 SINRHO COSSHO
1 OMEGA2
ROY
GDS ROG
GDR ROG
GDR HOR
GDP UDP
HTDR
MDR
  , YD( 9)
, SINGAM
, OCORHO
  ,SVY(10)
,SAVBP(15)
,OCORO2
   ,00V
,00G
,00R
,VDP
,600
   POV
POG
PDR
PDM
  , VDO
```

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# SUBRØUT I NE FH2

#### Subroutine FH2

Entry Points. FH2010, FH2001, FM2000

#### Purpose

Subroutine FH2 is the governing equation (XK1) associated with the thrust element in the in-plane control vector when the thrust is modeled as a vacuum thrust modified by a nozzle back-pressure correction.

#### Description

The solution of the in-plane control using the governing equations is described in Section 9 of Volume I. This subroutine is called from BLGCØN.

| FORTRAN | MATH              | 0000 | DESCRIPTION                                                                  |       |        | ORAC       |      | SUBBOUTIN                                                                                                                                                    |                                              |
|---------|-------------------|------|------------------------------------------------------------------------------|-------|--------|------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| SYMBOL  | SYMBOL            |      | DESCRIPTION                                                                  |       | BLOCK  | ζ <u> </u> | LOC  | SUBA COC                                                                                                                                                     | E VAR                                        |
| AE      | A <sub>exit</sub> | 1    | Total nozzle exit area                                                       |       | /GENF  | 70         | 520) | ACCEL I<br>FH2 I<br>IMPUL I<br>PROPB O<br>PROPIN O<br>SDER3 I                                                                                                | AE<br>AE<br>AE<br>AE<br>AE                   |
| FVAC    |                   | 1    | Total vacuum thrust frocket]                                                 | (LBS) | /GENF  | 70         | 528) | ACCEL I<br>EQUAS M<br>FH2 I<br>IMPUL M<br>PROPB M<br>PROPIN M<br>SDER3 I                                                                                     | FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC |
| PA      | p <sub>a</sub>    | I    | Atmospheric pressure                                                         | (PSF) | / GENF | /(         | 308) | EQUA3 M<br>FH2 I<br>IMPUL I<br>OUT I<br>PDBC I<br>SDER3 I                                                                                                    | DZM<br>PA<br>PA<br>PA<br>PA<br>PA            |
| PAR     |                   | I    | Deriv. Of press Wrt sit.                                                     |       | /GENF  | /(         | 312) | ACCEL I<br>FH2 I                                                                                                                                             | PAR<br>PAR                                   |
| Τ .     | T                 | I    | Thrust                                                                       | (LBS) | /GENF  | /(         | 411) | ACCEL I<br>BLGCON M<br>BL4 I<br>BL4 I<br>BL7 I<br>BL8 I<br>ECUA3 O<br>FH1 I<br>FH2 I<br>FH3 I<br>FH4 I<br>OUT I<br>PROPIN O<br>PROPIN O<br>REU3 O<br>SDER3 I | T                                            |
| XKI     |                   | 0    | First control vector governing equation value corresponds to error in thrust |       | /GENF  | 10         | 572) | BLGCON I<br>FH1 O<br>FH2 O<br>FH3 O<br>FH4 O<br>MODELA I                                                                                                     | XK1<br>XK1<br>XK1<br>XK1<br>XK1<br>XK1       |
| XK1R    |                   | 0    | Partial of governing equation mrt state or covector component                | ntrol | /GENF  | /(         | 593) | FH2 0<br>FH3 M<br>FH4 0                                                                                                                                      | XK1R<br>XK1R                                 |
| XKIT    |                   | 0    | Partial of governing equation wrt state or convector component               | ntrol | /GENF  | . /(       | 575) | BLGCON I<br>FH1 O<br>FH2 O<br>FH3 M<br>FH4 O<br>MODELA I                                                                                                     | XK1T<br>XK1T<br>XK1T<br>XK1T<br>XK1T<br>XK1T |

```
FH2
GENF
GENF
GENF
GENF
   1. 23.45.67.89.
  TOL(9) SVAB(1G)
COT1(9,9) DCON(9)
OPSQ AD
CSR VWR
TOP TOS
DIP(20) T
DIS1(20) TIME
TAX TBURM
FPD MACHR
LIFTV DRAGY
DB ULFTR
VMCGA XACGM
CDE ZELTAE
ZCG XJ
   , WBC(20)
DTP
QS
, CS
, SUMSQ
, TR(9)
, W
, OMP
, TBU(20)
, MACHY
  10.
   DRAGA
ISPF
ULFTA
CODAE
SID
   DBR
ULFT
XMCGR
CALPHA
XCG
                                *XMCS
*CULFT
*COD
*COMMON
*XJY
*FRATED
*P1
*XK1T
*XK1A
*XK1A
*XK1G
*XK1R
   ,XMCGV
,CT
,SIDAE
SENF /
XJR
,[RATED
20.
21.
22.
23.
   , GAMMAD
   , XKG
  , GH
   , XKP
                                  , XK1
, XK1D
, XK1V
, XK1P
, XK1O
, XK1M
, XK1M
   , XK2
, XK2D
, XK2V
, XK2P
, XK2O
, XK2M
, PO
   , xk3
, xk30
, xk30
, xk30
, xk30
, xk30
, xb30
, xb30
, xb30
, xb30
24.
25.
26.
27.
28.
30.
31.
                                 *XK1U
*PV
REAL
* ISP
  MACH,
   MÁCHR,
  GENF
GENF
GENTE30
STATE30
33.
34.
35
36
37
38.
39.
                                COMMON/ST
*YAR(14)
*XI(9,9)
*SIMPSI
*SYBY
*VOV
*UDV
*UDV
*UDR
*EOP
   DVARL(99)
COSSAM
,COSRHO
   ,54Y(10)
,5AY8P(15)
,0COR02
   ,YO(9)
,SINGAM
,OCORHO
                        ,000
,006
,00R
,VDP
,600
   PDV
PDG
PDR
PDM
VDO
  HOV
   , NDV
, ROG
, MOR
, MOM
, UOP
, HTOR
 41.
42.
43.
 44.
45.
46.
47.
  ,COS26M
  FH2
48,
50,
51,
53,
55,
55,
55,
   FH2
FH2
FH2
FH2
FH2
              ε
                                    RETURN
```

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# SUBRØUTINE FH3

### Subroutine FH3

# Entry Point. FH3010, FH3001, FH3000

### Purpose

Subroutine FH3 is the governing equation (XK1) associated with the thrust element in the in-plane control vector when the thrust is being throttled to maintain a limit total acceleration.

# Description

The solution of the in-plane control using the governing equations is described in Section 9 of Volume I. This subroutine is called from BLGC $\emptyset$ N.

| ORTHAN | HTAM                   | CODE | DESCRIPTION                         |       |         | RAC |      | SUBBOL                                                                  |                            |                                                                              |
|--------|------------------------|------|-------------------------------------|-------|---------|-----|------|-------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|
| SYMHOL | SYMBOL                 |      | DESCRIPTION                         |       | BLUCK   |     | LUL  | SUBR                                                                    | CODE                       | RAV                                                                          |
| CODAE  | cos(0-6 <sub>E</sub> ) | 1    | See symbol                          |       | /GENF   | /(  | 549) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>SOER3<br>VT                 | I<br>I<br>I                | CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE                  |
| C05A   | COS∝                   | I    | See symbol                          |       | /AECD3  | /(  | 8)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>OUT<br>VT                   | I<br>I<br>I<br>I<br>I<br>I | COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA                         |
| ов     | D <sub>b</sub>         | I    | Base drag                           | (LBS) | /GENF   | /(  | 537) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>OUT<br>SDER3<br>VT | I                          | 08<br>08<br>08<br>08<br>08<br>08<br>08<br>08                                 |
| DBR    |                        | I    | Partial of base drag ⊯rt altitude   |       | /GENF   | /(  | 536) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>VT                 | I<br>I<br>I                | DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR                                |
| OR A G | D                      | 1    | Aerodynamic drag                    | (LBS) | / GENF  | /(  | 497) | ACCEL BL5 BL7 BL8 ENVPRF FH3 OUT PROPB PROPIN SOER3                     | 1<br>1<br>0                | DRAG<br>ORAG<br>DRAG<br>ORAG<br>ORAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG |
| DRAGA  |                        | I    | Partial of drag mrt angle of attack |       | /GENF   | /(  | 534) | ACCEL<br>8L5<br>8L7<br>8L8<br>FH3<br>VT                                 | I<br>I<br>I<br>I           | DRAGA<br>DRAGA<br>DRAGA<br>DRAGA<br>DRAGA<br>DRAGA                           |
| DRAGR  |                        | I    | Partial drag mrt altitude           |       | /GENF   | /(  | 533) | ACCEL<br>BL5<br>BL7<br>BL8<br>FH3<br>VT                                 | I<br>I<br>I<br>I<br>M      | DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR                           |
| DRAGV  |                        | I    | Partial of drag mrt velocity        |       | /GENF   | /(  | 532) | ACCEL<br>BL5<br>BL7<br>BL8<br>FH3<br>VT                                 | I<br>I<br>I<br>I           | DRAGV<br>DRAGV<br>DRAGV<br>DRAGV<br>DRAGV<br>DRAGV                           |
| GMAX   | G <sub>MAX</sub>       | I    | Maximum total acceleration g load   |       | /ARCOAT | 70  | 12)  | BL5<br>FH3<br>MODELA<br>PROPB<br>PROPIA                                 | I                          | GMAX<br>GMAX<br>GMAX<br>GMAX<br>GMAX                                         |

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| FORTRAN<br>Symbol | MATH<br>Symbol         | COOS | DESCRIPTION                                      |                              | BLOCK   | RAG | FOC  | <u>208469</u>                                                                                                                                                      | LODE V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------|------------------------|------|--------------------------------------------------|------------------------------|---------|-----|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GR                | 9,                     | 1    | Gravitational acceleration at surface of the (FT | earth<br>/SEC <sup>2</sup> ) | /GLOBAL | ./( | 1)   | ACCEL<br>BL5<br>EQUA3<br>FH3<br>GEINP<br>GEINP<br>GEINP<br>OUT<br>PADS1<br>PADS1<br>PADS1<br>PADS1<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE | GRAGE |
| LIFT              | l.                     | I    | Aerodynamic lift                                 | (LB5)                        | /GENF   | /(  | 496) | ACCEL<br>BL4<br>BL5<br>BL6<br>ENVPRM<br>FH3<br>OUT<br>PROPIN<br>VT                                                                                                 | I LIF<br>I LIF<br>O LIF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| LIFTA             |                        | I    | Partial of lift wrt angle-of-attack              |                              | /GENF   | /(  | 531) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VI                                                                                                                            | I LIF<br>I LIF<br>I LIF<br>I LIF<br>O LIF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| LIFTM             |                        | I    | Partial of LiFT wrt wass                         |                              | /GENF   | 10  | 535) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                                                                                                                            | I LIF<br>I LIF<br>I LIF<br>I LIF<br>I LIF<br>O LIF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| LIFTR             |                        | I    | Partial of lift ert altitude                     |                              | /GENF   | /(  | 530} | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                                                                                                                            | 1 LII<br>1 LII<br>1 LII<br>1 LII<br>0 LII                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| LIFTV             |                        | I    | Partial of lift mrt velocity                     |                              | /GENF   | /(  | 529) |                                                                                                                                                                    | I LII<br>I LII<br>I LII<br>I LII<br>O LII                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| SIDAE             | sin(α-ε <sub>Ε</sub> ) | 1    | See symbol -                                     |                              | /GENF   | /(  | 557) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>VT                                                                                                                     | 1 SII<br>I SII<br>I SII<br>I SII<br>I SII<br>I SII                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| SINA              | sìn∝                   | I    | See symbol                                       |                              | /AEC03  | /(  | 7)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>GUI3A<br>OUT<br>VT                                                                                                     | I SII I SII I SII I SII I SII M SII M SI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

| FORTRAN | MATH   | ดอา | DESCRIPTION                                                                  |    |        | OBAG |      | 5 UNE 0 U                                                                                               |                                                                                             |                                              |
|---------|--------|-----|------------------------------------------------------------------------------|----|--------|------|------|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------|
| SYMBOL  | SYMBOL |     | DESCRIPTION                                                                  |    | BLÜU   | `    | LOL  | 508R (                                                                                                  | NOF                                                                                         | PAR                                          |
| Ţ       | T      | ī   | Thrust                                                                       | 5) | /GENF  | /(   | 411) | ACCELN<br>BLGCON<br>BL6<br>BL7<br>BL2<br>EQUA3<br>FH2<br>FH2<br>FH2<br>IMPUL<br>PROPIN<br>REUS<br>SUERS | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;       |
| W       | М      | I   | Weight (LE                                                                   | 51 | / GENF | /(   | 412) | BL5<br>ENVPRM<br>EQUA3<br>FH3<br>OUT<br>PDBC<br>REU3<br>TRTOSZ                                          | I                                                                                           | 다<br>역<br>역<br>역<br>역<br>역<br>역              |
| XKI     |        | O   | First control vector governing equation value corresponds to error in thrust |    | /GENF  | 10   | 572) | BLGCON<br>FH1<br>FH2<br>FH3<br>FH4<br>MODELA                                                            | 0 0                                                                                         | KK1<br>KK1<br>KK1<br>KK1<br>KK1              |
| XK1A    |        | M   | Partial of governing equation art state or controvector component            | i  | /GENF  | /(   | 581) | 8LGCON<br>FH3                                                                                           |                                                                                             | KK1A<br>KK1A                                 |
| XKID    |        | M   | Partial of governing equation wrt state or controvector component            | i  | /GENF  | /(   | 578) | BLGCON<br>FH3                                                                                           |                                                                                             | KK1D<br>KK1D                                 |
| XK1M    |        | M   | Partial of governing equation ært state or controvector component            | I  | /GENF  | /(   | 602) | FH3                                                                                                     | Ħ,                                                                                          | KK1M                                         |
| XK1R    |        | M   | Partial of governing equation art state or controvector component            | 1  | /GENF  | /(   | 593) | FH2<br>FH3<br>FH4                                                                                       | Ħ                                                                                           | KK1R<br>KK1R<br>KK1R                         |
| XK1T    |        | m   | Partial of governing equation mrt state or controvector component            | i  | /GENF  | /(   | 575) | BLGCON<br>FH1<br>FH2<br>FH3<br>FH4<br>MODELA                                                            | 0<br>B<br>M<br>0                                                                            | XK1T<br>XK1T<br>XK1T<br>XK1T<br>XK1T<br>XK1T |
| XK1A    |        | M   | Partial of governing equation wrt state or controvector component            | i  | /GENF  | /(   | 584) | BLGCON<br>FH3<br>FH4                                                                                    | ri                                                                                          | KK1V<br>KK1V                                 |

```
SUBROUTINE FM3
COMMON/ARCDAT/
*SREF EJ
*IATM IMO
*XLMAX HDM
*MAEB MAEB
  FH3
ARCDAT
ARCDAT
ARCDAT
ARCDAT
 1
2
3.
4.
5.
6
7
8
9
  ,EJ
,IMODE
,HDMAX
,MAEC
,MISP
,XCGR
  ,X1SP
,JAER
,GMDDT
,MAED
,MXCG
,ZCGR
   TMULT
JPRO
ALFMAX
MAEE
MZCG
   DTNC
QMAX
PHMAX
MAEF
MUDA
   DTP1
SMAX
MAEA
MAES
MAES
MUDB,
   ARCDAT
ARCDAT
ARCDAT
ARCDAT
RETAP
  +MT
+MDB
   *MOB XCGM 2:
*DREF MCND RI
*FRATE ARCD(9)
DIMENSION ARCDA(40)
EDUIVALENCE(SREF, ARCDA)
COMMON/GENF/
  OMULT
   REMAX
   RHOB
  ARCDAT
ARCDAT
GENF
 11
12
13
14.
15.
16
  TOL(9)
, COTI(9,9)
, DPSQ
, PA
, TOP
, DIP(20)
, DISI(20)
, TAX
, FPD
, LIFTV
, ORASV
, DB
, ULFTV
, CDE
, ZCG
  COMMON/56

*OMG(20)

*A(9,9)

*BTS

*R

*R

**NU

*SVSQ

*TST(20)

*TLP1(20)

*TLP1(20)

*TIMPR

*AE

*AE

*AE

*AE
   , WDC(20)

OTP

, QS

, CS

, SUMSQ

, TR(9)

, M

, OMP

, TBU(20)

, MACHY
  GENF
GENF
GENF
GENF
GENF
GENF
GENF
   ,SVAR(10)
   RO
VAR
TOS
18,01221224567890123456...
   TIME
TBURN
MACHE
  GENF
GENF
GENF
GENF
GENF
GENF
GENF
  DRAGR
ISP
ULFTR
XMCGM
DELTAE
   CRASA
ISPF
ULFTA
CODAE
,510
   DBR
ULFT
XMCGR
CALPHA
XCG
  XMCGV
CT
SIDAE
GENF /
XJR
, IRATED
                                  *XAC6
  *CULFT
*COB
   , GAMMAD
   , XKG
   , XKP
  GENE
   , XK2
, XK2D
, XK2V
, XK2P
, XK2O
, XK2M
, PO
  , XK1
, XK10
, XK1V
, XK1P
, XK10
, XK1A
   , XK3
, XK3D
, XK3P
, XK3D
, XK3M
, DPDY(3,8)
  GENF
GENF
   GENF
GENF
GENF
GENF
FRAT
GENF
FRATE3D
STATE3D
STATE3D
STATE3D
STATE3D
 38.
 39.
40.
  41.
  MACH,
  MÁCHR,
444444444555555555555666666668777775
  , DVARL( 99 )
(COSGAM
   , YO(9)
.SINGAM
   ,SVY(10)
,SAVBP(15)
,OCORO2
  COSRHO
   *SINP$! COSP$1
*SVBV (9).0MEGA
*VOV '906
*UDV 'V0B
*UDB 'V0B
*UDB 'V0B
*IDB 'V0B
*GDP 
  OCORHO
  STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
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STATE30
STATE30
   000
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90V
900
   , PBV
  , PDG
, PDR
, PDM
, VDO
  HTDR
   . COS26M
  GLOBAL
  GLOBAL
GLOBAL
GLOBAL
GLOBAL
GLOBAL
RETAP
AECO3
   ,LUM
,ID(4)
  ,YMURF
,NFARC
  IPFLG2,IPFLG3,IPFLG4,INEQFL(20)
   AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
FH3
FH3
  , VDA
, PHID
, XLAMA(9)
, XCSM
, CMO
, CLM
  ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMDM
   ,PDA
,SINPHI
,CDG
,CLGM
,FKM
                             ε
   ENTRY FH3010
```

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```
ASSIGN 20 TO 160
60 TO 4
ENTRY FH3001
ASSIGN 40 TO 160
60 TO 5
ENTRY FH3000
ASSIGN 50 TO 160
60 TO 5
            76.
77
78
79.
80.
81
82.
83.
  FH3
FH3
FH3
FH3
FH3
FH3
FH3
  C
  4 T5 = -DRAGR - DBR*COSA

T6 = LIFTR - DBR*SINA

5 TCDAE = T*CODAE

TSDAE = T*SIDAE

DBCA = DB*COSA

DBSA = DB*SINA

ZZ = -TSDAE + DBSA

YY = -TCDAE + DACA

T1 = -YY - DRAG

T2 = LIFT - ZZ

T3 = ZZ - DRAGA

T4 = LIFTA - YY

GO TO IGO
             85
86.
  FH3
FH3
87.
88.
89.
90.
91.
92.
93.
94.
95.
96.
100.
101.
102.
103.
104.
1105.
1106.
1107.
1108.
1109.
1110.
  GO TO IGO

20 XKIV = ASF(-DRAGY, LIFTV)
    XKIV = XKIV + XKIV
    XKIR = ASF(TS, TG)
    XKIR = XKIR + YKIR
    XKIR = XKIR + YKIR
    XKIR = XKIR + XKIR

40 XKIT = ASF(CODAE, SIDAE)
    XKIT = XKIT + XKIT
    XKID = ASF(TSDAE, -TCDAE)
    XKID = XKID + XKID
    XKID = XKID + XKID
    XKIA = ASF(TS, TA)
    XKIA = ASF(T3, TA)
    XKIA = ASF(T1, T2) - (GMAX+W)++2
    RETURN
    END
```

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# SUBRØUT I NE FH4

### Subroutine FH4

# Entry Points. FH4010, FH4001, FH4000

## Purpose

Subroutine FH4 is the governing equation (XK1) associated with the thrust element in the in-plane control vector when the airbreathing propulsion option is used.

## Description

The solution of the in-plane control is described in Section 9 of Volume I. This subroutine is called from BLGC $\phi$ N.

| FORTRAN | MATH   | CODE                           | DESCRIPTION                                         |        |         | RAGE   |                                                                                                                      | TINE US                               |             |
|---------|--------|--------------------------------|-----------------------------------------------------|--------|---------|--------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------|
| SYMBOL  | SYMBOL | OUL                            | DESCRIPTION                                         |        | BLOCK   | LOC    | SUBR                                                                                                                 | CODE V                                | AR          |
| ī       | Ţ      | I Thrust                       |                                                     | (L85)  | / GENF  | /( 411 | ACCEL<br>BLGON<br>BL6<br>BL6<br>BL7<br>BL2<br>BL2<br>EQUA<br>FH1<br>FH3<br>FH4<br>IMPUL<br>PROPIN<br>REDER<br>BUER 3 | T T T T T T T T T T T T T T T T T T T |             |
| TAIRB   |        | I Airbreather                  | thrust.                                             | (LBS)  | /AIRBRE | E/{ 1  | ) EQUA3<br>FH4                                                                                                       | I TAI                                 |             |
| HARRAT  |        | I Partial of a                 | irbreather thrust WRT altitude                      |        | /AIRBRE | E/( 3  | ) ACCEL<br>FH4                                                                                                       | I TAI<br>I TAI                        |             |
| TAIRBV  |        | I Partial of a                 | irbreather thrust WRT velocity                      |        | /AIRBRE | E/( 2  | ) ACCEL<br>FH4                                                                                                       | I TAI<br>I TAI                        | RBV<br>RBV  |
| XKI     |        | D First contro<br>corresponds  | I vector governing equation valuate error in thrust | e      | /GENF   | /( 572 | BLGCON<br>FH1<br>FH2<br>FH3<br>FH4,<br>MODELA                                                                        | 0 XK1<br>0 XK1<br>0 XK1               |             |
| XKIR    |        | O Partial of g<br>vector compo | overning equation wrt state or conent.              | ontrol | /GENF   | /( 593 | FH2<br>PH3<br>FH4                                                                                                    | 0 XK1                                 | R           |
| XKIT    |        | 0 Partial of g<br>vector compo | overning equation wrt state or to<br>nent           | ontroi | /GENF   | /( 575 | BLGCON<br>FH1<br>FH2<br>FH3<br>FH4<br>MODELA                                                                         | 0 XK1<br>0 XK1<br>0 XK1               | T<br>T<br>T |
| XK1 A   |        | O Partial of g<br>vector compo | overning equation wrt state or conent               | ontrel | /GENF   | /( 584 | BLGCON<br>FH3<br>FH4                                                                                                 | I XK1<br>M XK1<br>O XK1               | ٧           |

```
FH4 DB BAAL
BABAAL
BABA
, MOC(20)
DTP
, QS
, CS
, SUMSQ
, TR(9)
, OMP
, TBU(20)
, MACHY
  , XK2
, XK3D
, XK3D
, XK2V
, XK3V
, XK2P
, XK3P
, XK3D
, XK3D
, XK3M
, DPBY(3,8)
, MACH, MACHR,
   GEN4
GEN4
FHH4
FHH4
FHH4
FHH4
FHH4
FHH4
   C
   ENTRY FH4001
XK1T = 1.
  C
  ENTRY FH4000
XK1 = T - TAIRB
RETURN
```

20 act 72 6 01-46

# SUBRØUT I NE FNTG

#### FNTG

# Purpose

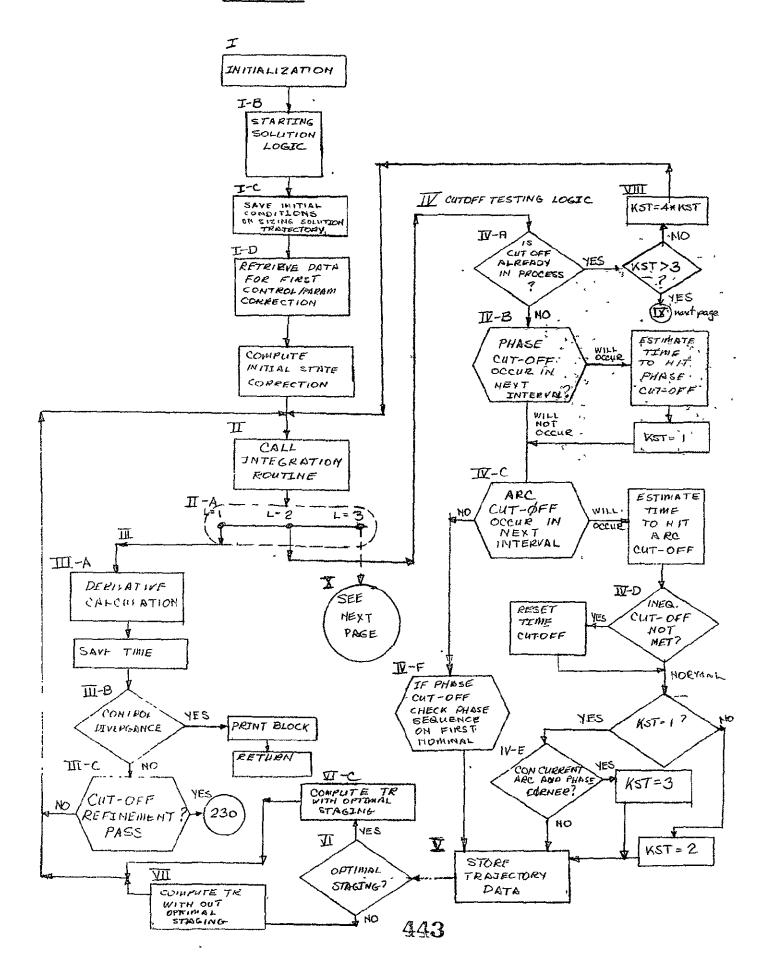
FNTG controls integration of forward trajectory and all subsidiary functions.

### Description

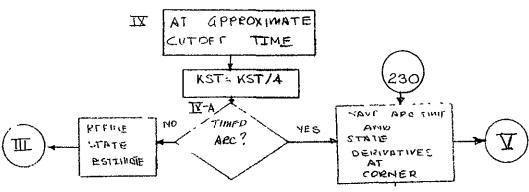
FNTG is a subroutine in the UNIVAC version of the program, however, in the CDC version of PADS it is a "Program" which heads up the largest overlay in the steepest descent module.

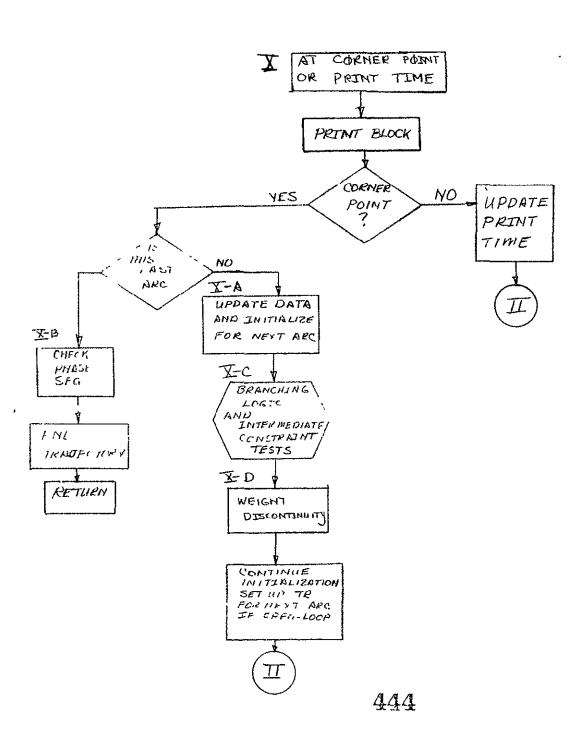
The logic in this program is geared mainly to the Runge-Kutta numerical integration subroutine, RKUTTA. Through the use of the traffic flag, L. The meanings of L are listed below.

- L = 1, Evaluate derivatives
- L = 2, Check cut-off and store data
- L = 3, At corner point or print time
- L 4, Restart integration.



J





| MARIRO | MATH             | Cons | DESCRIPTION                                                 |                    | STORA     |      | SUBROUTI                                                                                                           |                                                                                                 |
|--------|------------------|------|-------------------------------------------------------------|--------------------|-----------|------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| SYMADL | SYMBOL           | CODE | DESCRIPTION                                                 |                    | BLOCK     | LOC  | 2084 CO                                                                                                            | DE VAR                                                                                          |
| ALPHA  | α                | Q.   | Angle of attack                                             | (RAD)              | /AEC03 /( | 31   | BEROCO I<br>BLGCON M<br>BL2 I<br>FNTG O<br>MAMECO I<br>MODELA M<br>MODELB O<br>REU3 VT                             | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA                                              |
| APHO   | ∝old             | Ī    | Angle of attack from last nominal trajectory                | (DEG)              | /AEC03 /( | 1)   | AST3 MENTG I METX3A I OUT I PROPB OPROPIN O                                                                        | APHO<br>APHO<br>APHO<br>AEZRO                                                                   |
| ARCDA  | S <sub>ref</sub> | I    | Aerodynamic reference area                                  | (FT <sup>2</sup> ) | /ARCDAT/( | 1)   | BNTG I<br>EQUAS I<br>FNTG I<br>FXDAT I<br>GEINP M<br>SDINP I<br>SIZIN I<br>SIZIN M<br>THRUST I<br>VT               | ARCDA<br>ARCDA<br>ARCDA<br>SREF<br>SREF                                                         |
| DIP    |                  | 0    | Array of phase end integration intervals for trajectory     | trial              | /GENF /(  | 391) | BNTG I                                                                                                             |                                                                                                 |
| DIS    |                  | 0    | Array of arc end integration intervals for tr<br>trajectory | ıai                | /GENF /{  | 371) | BNTG I                                                                                                             |                                                                                                 |
| DT     |                  | M    | Integration interval                                        | (SEC)              | /GENF /(  | 300) | BNTG F<br>FNTG M<br>REU3 I<br>RKTA3A I<br>RKTB3A I<br>STP3 I<br>YREF3 0                                            | DT<br>DT<br>ST<br>P<br>P<br>P<br>DT                                                             |
| DTNC   | Δτ               | I    | Integration interval                                        | (SEC)              | /ARCDAT/( | 5)   | BNTG I<br>FNTG I<br>GEINP P<br>PROPIN I                                                                            | DTNC<br>DTNC                                                                                    |
| DTP    |                  | M    | Altered integration interval read to hit phase off [sd]     | (SEC)              | /GENF /(  | 298) | FNTG P                                                                                                             | DTP                                                                                             |
| DTPI   |                  | I    | Print frequency for trajectory                              |                    | /ARCDAT/( | 6)   | FNTS I                                                                                                             |                                                                                                 |
| DTS    |                  | M    | Altered integration interval read to hit arc off [sd]       | cut-<br>(SEC)      | /GENF /(  | 299) | FNTG #                                                                                                             |                                                                                                 |
| IARC   |                  | M    | Arc number                                                  |                    | /XCODES/( | 146) | ADICB3 I ADIUST I AST3 I BNTG I ENVPRM I FNTG I FNTG I FNTG I FROPB I PROPB I PROPB I PROPB I STAU I STAU I TRTOSZ | IARCC<br>IARCC<br>IARCC<br>IARCC<br>IARCC<br>IARCC<br>IARCC<br>IARCC<br>IARCC<br>IARCC<br>IARCC |

| FORTRAN<br>SYMBOL | MATH<br>Symbol | CODE | DESCRIPTION                                                                         | S TORAC<br>BLOCK | LOC  | SUBROUTING SUBR COOK                                                                        |                                                                                        |
|-------------------|----------------|------|-------------------------------------------------------------------------------------|------------------|------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 1 COB             |                | Į (  | Phase sequence array                                                                | /xcodes/(        | 10)  | ADJUST I<br>FNTG I<br>PRMSET I<br>SDINP M                                                   | ICOR<br>ICOR<br>ICOR<br>ICOR                                                           |
| IND               |                |      | Fiag indicates whether on first nominal trajectory (IND=1)                          | /XCODES/(        | 141) | AST3 1<br>BGET3 1<br>FNTG M<br>GUI3A I<br>MTX3A 1<br>PROPIN 1                               | ON I<br>ON I<br>ON I<br>ON I<br>ON I                                                   |
| <b>B</b> TNI      |                | 1 8  | Branching and intermediate constraint flag                                          | /XCDDES/(        | 31)  | ADIC3A I<br>BNTG I<br>ENVPRM I<br>FNTG I<br>SDINP M<br>TEST I<br>TRAN3 I<br>TRTOSZ I        | INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB                                   |
| IOPEN             |                | M (  | Closed to open-loop control switch when equal to 2                                  | /XCBDES/(        | 142) | FNTG M<br>PROPIN O                                                                          | IOPEN<br>IOPEN                                                                         |
| IPFLG1            |                |      | IPFLG1#0 supresses print-out of velocity losses and inertial Euler angles.          | /GLOBAL/(        | 69)  | FNTG I<br>OUT I<br>PDBC I<br>PRINT I<br>TRTOSZ O                                            | IPFLG1<br>IPFLG1<br>IPFLG1<br>IPFLG1<br>IPFLG1                                         |
| IPH               |                | r) F | Phase number                                                                        | /XCODES/(        | 143) | ADID3A I<br>ADJUST I<br>AST3 I<br>BNTG M<br>FNTG M<br>GETIT I<br>GUI3A I<br>SDINP M         | IPH IPH IPH IPH IPH IPH IPH IPH IPH                                                    |
| 1PST              |                | ri i | Phase counter for first nominal trajectory                                          | /XC00ES/(        | 167) | AST3 I<br>FNTG M<br>GUI3A I<br>REU3 I                                                       | IPST<br>IPST<br>IPST<br>IPST                                                           |
| ISPH              |                | 0 5  | Sign of phase cut-off                                                               | /XCODES/(        | 144) | FNTG O<br>STP3 I                                                                            | ISPH<br>ISPH                                                                           |
| ISST              |                | 0 5  | Sign of arc cut-off                                                                 | /XCODES/(        | 145) | FNTS 0<br>STP3 I                                                                            | ISST<br>ISST                                                                           |
| ISTART            |                | 1    | Instialszation and divergance flag                                                  | /XCODES/(        | 147) | AST3 OBLGCON OBLYNE OFNTG I MODELA OPROPIN OREUS I TEST MODPM M                             | ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART |
| ISTOP             |                | 14   | Arc cut-off flag                                                                    | /XCODES/(        | 175) | FNTG M<br>STP3 I                                                                            | ISTOP<br>ISTOP                                                                         |
| ISTPP             |                | M I  | Phase cut-off flag                                                                  | /XCODES/(        | 176) | FNTG M<br>STP3 I                                                                            | ISTPP<br>ISTPP                                                                         |
| ITER              |                | I    | Trajectory pass indicator.  ITER = 1, CONSTRAINTS  = 2, OPTIMIZATION  = 3, SOLUTION | /XCODES/(        | 149) | AST3 I<br>FNTG I<br>GETIT I<br>MODELA I<br>OUT I<br>PAYO2 M<br>PROPIN I<br>TEST M<br>TOPM M | TTER TTER TTER TTER TTER TTER TTER TTER                                                |
| ITI               |                | 1    | Optimized arc time flag                                                             | /XCODE5/{        | 30)  | ADJUST M<br>FNTG I<br>SDINP O                                                               | ITI<br>ITI<br>ITI                                                                      |

30 OCT 72 G.01-46

| ORTRAN<br>Symbol | MATH<br>Symbol | CODE                               | DESCRIPTION                                                                                                                              | STORAGE<br>BLOCK LOC | SUBROUTIN<br>SUBR COO                                                                           |                                              |
|------------------|----------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------|
|                  |                |                                    |                                                                                                                                          |                      |                                                                                                 |                                              |
| ITT              |                |                                    | when derivatives were last evaluated                                                                                                     |                      | FNTG W                                                                                          | ITT                                          |
| IVAR             |                | M Cut-off v∎                       | riable option indicator                                                                                                                  | /XC00ES/( 150)       | FNTG M<br>STP3 D<br>TOL3 I                                                                      | IVAR<br>IVAR<br>IVAR                         |
| <b>J61</b> D     |                | I Control op                       | tion flag array                                                                                                                          | /xcode\$/( 32)       | BNTG I<br>FNTG I<br>SDINP M                                                                     | JGID<br>JGID                                 |
| 1611             |                | M Control op                       | tion -                                                                                                                                   | /XCODES/( 195)       | ACCEL I<br>BNTG D<br>DER3A I<br>FNTG M<br>GUI3A I<br>MODELA I<br>MODELB I<br>MTX3A I<br>PDY3A I | 1611<br>1611<br>1611<br>1611<br>1611<br>1611 |
| JPH              |                | M Phase cut-                       | off option flag                                                                                                                          | /XCODES/( 72         | BNTG I<br>FNTG M<br>SDINP M                                                                     | ЈРН<br>ЈРН<br>ЈРН                            |
| JP5              |                | M Absolute v                       | alue of phase cut-off option code                                                                                                        | /XCODES/( 152)       | ADID3A I<br>BNTG M<br>FNTG M<br>STP3 I<br>TOL3 I                                                | JPS<br>JPS<br>JPS<br>JPS<br>JPS              |
| js               |                | M Absolute v                       | alue of arc cut-off option, code .                                                                                                       | /xcqDES/( 153)       | ADICB3 M<br>ADICBA I<br>ADICBA I<br>BNTG M<br>FNTG M<br>PROPB I<br>PROPIN I<br>STP3 I<br>TUL3 I | 12<br>12<br>12<br>12<br>12<br>12<br>12<br>12 |
| TZL              |                | I Arc cut-of                       | foption flag                                                                                                                             | /XCODES/( 112)       | ADICB3 I<br>BATG I<br>FATG I<br>SDINP M                                                         | TZL<br>TZL<br>TZL<br>TZL                     |
| К                |                | 0 Storage re<br>or data.           | trieval flag indicates end of arc, phase,                                                                                                | /xcooes/( 156)       | AST3 0<br>FNTG 0<br>GETIT M<br>MODELA I<br>SDINP M                                              | K<br>K<br>K<br>K                             |
| KPST             |                | M Controls !<br>integratio         | ogic for compute interval during adjoint                                                                                                 | /xcodes/( 155        | BNTG M                                                                                          | KPST<br>KPST                                 |
| KSOL             |                | l An interna<br>ITPSO.             | I flag that has the same significance as                                                                                                 | /GLOBAL/( 94)        | FNTG I<br>PADS1 O<br>SDINP M                                                                    | KSOL<br>KSOL<br>KSOL                         |
| KST              |                | M Arcorpha                         | se cut-off flag                                                                                                                          | /xcodes/( 157)       | ADJUST I<br>FNTG M                                                                              | KST<br>KST                                   |
| L                |                | L = 1<br>= 2                       | n traffic control flag<br>means evaluate derivatives<br>check cut-off<br>print or cut-off detected                                       | /XC00ES/( 177)       | BNTG M<br>FNTG M<br>OUT I<br>RKTASA M<br>RKTBSA M<br>SDINP M                                    | L<br>L<br>L<br>L                             |
| LUM              |                | ั L∪M =<br>L∪M =<br>trans<br>L∪M = | introl flag.  O. Steepest descent only;  I Steepest descent and adjoint  formation stored on tape,  Steepest descent and OL,  3 QL only. | /GLOBAL/{ 6          | AST3 I<br>FNTG I<br>GEINP I<br>PADS1 M<br>SDINP I<br>TOPM M                                     | LUM<br>LUM<br>LUM<br>LUM<br>LUM<br>LUM       |
| NARC             | N <sub>3</sub> |                                    | subarcs in the problem.                                                                                                                  | /GLOBAL/( 18         | FNTG I<br>GEINP M<br>PROPIN I<br>SDINP I<br>SIZIN I                                             | NARC<br>NARC<br>NARC<br>NARC<br>NARC         |

| PARIAN              | MATH   | CODE DESCRIPTION                                                                             |       | STORA         |      | SUBROUTINE USAG                                                                                                                        |
|---------------------|--------|----------------------------------------------------------------------------------------------|-------|---------------|------|----------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL              | SYMBOL | DESCRIPTION                                                                                  |       | <u>ar</u> ork | LOC  | SUBR LOVE VAR                                                                                                                          |
| NP A                |        | 1 Running count of number of adjustable parameter<br>be perturbed on remainder of trajectory | rs to | /PARAM /(     | 14)  | ADJUST M NPAR<br>FNTG I NPA<br>MTX3A I NPA<br>TOPM D NPA                                                                               |
| NP AR A             |        | 1 Number of adjustable parameters in trajectory problem.                                     |       | /PARAM /(     | 13)  | ADJUST I NPARA BNIG I NPARA FNIG I NPARA FNIG I NPARA PAYOZ I NPARA PAYOZ I NPARA SOINP M NPARA STAU I NPARA TEST I NPARA TOPM D NPARA |
| NPH                 |        | 0 Number of phases in trajectory                                                             |       | /XCODE5/(     | 164) | BNTG I NPH<br>FNTG 0 NPH<br>PRMSET 1 NPH<br>SDINP M NPH<br>TEST I NPH<br>TOPM I NPH                                                    |
| NSAB                |        | I Number of arcs on first branch                                                             |       | /XCODES/(     | 134) | ADICOS I NSAB<br>BNTG I NSAB<br>ENVPRM I NSAB<br>FNTS I NSAB<br>SDINP M NSAB<br>TEST I NSAB<br>TRAMS I NSAB<br>TRAMS I NSAB            |
| <b>ĕ</b> 2 <i>n</i> |        | I Number of arcs prior to branch point or intermediate constraint                            |       | /XCODES/(     | 133) | ADICB3 I NSB<br>BNTG I NSB<br>ENVPRM I MSB<br>FNTG I NSB<br>REU3 I NSB<br>SDINP M NSB<br>TEST I NSB<br>TRANS I NSB<br>TRANS I NSB      |
| NST                 |        | 0 Nu≋ber of arcs in trajectory                                                               |       | /XCODES/(     | 166) | BNTG 1 NST<br>FNTG 0 NST<br>PROPB I NST<br>SDINP 1 NS<br>SDINP M NST<br>TEST I NST<br>TOPM I NST<br>TRAN3 I NST                        |
| OMG                 | Ω      | I Array of arc cut off values [sd]                                                           |       | /GENF /(      | 1)   | ADJUST M OMG<br>FNTG I OMG<br>PRMSET M OMG<br>PROPB I OMG<br>SDINP M OMG<br>STP3 I OMG<br>TOPM D IDMG                                  |
| OMGP                |        | M Array of phase cut off values [sd]                                                         |       | /GENF /(      | 21)  | ADJUST 0 OMGP<br>FNTG M OMGP<br>PRMSET 0 OMGP<br>SDINP M OMGP                                                                          |
| Omp                 |        | M Phase cut-off value                                                                        |       | /GENF /(      | 494) | ADJUST O OMP<br>FNTG M OMP<br>STP3 I OMP                                                                                               |

| FORTRAN<br>Symbol | MATH<br>Symbol     | CODE | DESCRIPTION                                                                                    |       | 8 L Q L        | ORAGI<br>K | LOC  | SUBROU<br>SUBR                                                                                                      |                                      | E USAGE<br>E VAR                                                   |
|-------------------|--------------------|------|------------------------------------------------------------------------------------------------|-------|----------------|------------|------|---------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------|
| RAD               |                    | 1    | Radian to angle conversion, 57.29577951                                                        |       | /DATA          | /(         | 2)   | BEROCO<br>BLGCON<br>ENVPRM<br>EQUA3<br>FNTG<br>GUI3A<br>MODELA<br>MTX3A<br>DUT<br>PADS1<br>PADS1<br>SDINP<br>TRTOSZ | I<br>I<br>I<br>I<br>I<br>I<br>I<br>I | DEG<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD |
| RDI               | ,                  | I    | Angle to radian conversion, .01745329252                                                       |       | /DATA          | /(         | 3)   | BLICO<br>DERSA<br>FNTG<br>GUISA<br>MODELA<br>MODELB<br>PAOS1<br>PROPBIN<br>REUS<br>SDINP<br>SOMG                    | I<br>D<br>I                          | RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI |
| STT<br>SVAR       | y   <sub>t=0</sub> |      | Last time value when derivatives mere evaluat<br>Array of state values at initial problem time |       | /FNTG<br>/GENF | /(*<br>/(  |      | FNTG<br>ADJUST<br>BNTG<br>FNTG<br>PRMSET<br>REU3<br>SDINP<br>TEST<br>TOPM<br>TRTOSZ                                 | I<br>M<br>I<br>M<br>I                | STT SVAR SVAR SVAR SVAR SVAR SVAR SVAR SVAR                        |
| TIME              | t                  | rq   | Time (elapsed)                                                                                 |       | /GENF          | /(         | 493) | ADICB3 AST3 BNTG CON3 DTF3 ENVPRM EQUA3 FNTG                                                                        |                                      | TIME TIME TIME TIME TIME TIME TIME TIME                            |
| TIMEPH            | Υ <sub>p</sub>     | M    | Phase time                                                                                     | (SEC) | /GENF          | /(         | 318) | EQUA3<br>FNTG<br>GETIT<br>GUI3A<br>OUT                                                                              | 0<br>m<br>I<br>I<br>I                | TIMEPH<br>TIMEPH<br>TIMEPH<br>TIMEPH<br>TIMEPH                     |
| TIMES             | 7                  | Ħ    | Arc time                                                                                       | (SEC) | /GENF          | /(         | 319) | AST3<br>EQUA3<br>FNTG<br>GETIT<br>OUT                                                                               | I<br>0<br>m<br>I<br>I                | TIMES<br>TIMES<br>TIMES<br>TIMES<br>TIMES                          |
| TIMPR             |                    | M    | Trajectory print time                                                                          |       | /GENF          | /(         | 495) | BNTG<br>FNTG<br>RKTA3A<br>RKTB3A                                                                                    |                                      | TIMPR<br>TIMPR<br>TP<br>TP                                         |
| TOP               |                    | M    | Elasped time at phase initiation                                                               |       | /GENF          | /(         | 320) | BNTG<br>EQUA3<br>FNTG                                                                                               | M<br>I<br>M                          | TOP<br>TOP<br>TOP                                                  |

| FORTRAN | MATH   | CODE | DESCRIPTION                                       | 5 T i  | BAR |      | 5 UBROU                                            | TINE         | USAGE                                |
|---------|--------|------|---------------------------------------------------|--------|-----|------|----------------------------------------------------|--------------|--------------------------------------|
| SYMBOL  | SYMBOL |      | DESCRIFTION                                       | BLOCK  |     | LOC  | รบธม                                               | CODE         | VAR                                  |
| TOS     |        | m    | Elasped time at arc initiation                    | /GENF  | 70  | 321) | BNTG<br>EQUA3<br>FNTG                              | rı<br>I<br>M | TOS<br>TOS<br>TOS                    |
| TPH     |        | 0    | Array of phase end times on trial trajectory [sd] | /GENF  | /(  | 351) | FNTG<br>TEST                                       | 0            | TPH<br>TPH                           |
| TST     |        | 0    | Array of arc end times on trial trajectory [sd]   | /GENF  | /(  | 331) | AOICB3<br>BNTG<br>FNTG<br>TEST                     | I<br>0<br>I  | TST<br>TST<br>TST<br>TST             |
| MDRK    |        | I    | Working array, contains TOPEN1, TOPEN2, and PHIWT | /\$T\$ | 70  | 3)   | ADEQ3A<br>FNTG<br>MODELB<br>MTX3A<br>SDINP<br>TEST | Ì            | WORK<br>WORK<br>WORK<br>WORK<br>WORK |

| COMMON / +1TQ (2 +JST (2 +JST (2 +JST (2) +120P * +120P * +170P * +NON * +NST NB * +1F0B * +NCTIN * +1F0B * +NCTIN * +1F0B * +NCTIN * +1F0B * +NCTIN * +1F0B * +1F1D *                   | TRAFFIC FLAG /XCODES/ (9), ICOR (220) ICOP IPH ITER , NEGRA IPST , NB LK1 , NB GENF/ OMGP(20, OCON(9), OCON(9) , PER , PAR , TIMEPH , TIMETH , TIMEPH , TIME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 3 PRINT  O), ITI NCNST IFAW ISPH IVAR KQ NEQ IPRINT LB LK2 AB(8), JPRP, J CON(9) GCON(9) GCON(                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | DERIV. 2<br>OR CORNER<br>INTE<br>INTE<br>INTE<br>INTE<br>INTE<br>INTE<br>INTE<br>INTE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ,NSAB<br>,IFB<br>,IARC<br>,JPS<br>,NAD<br>,NPH<br>,IPHN<br>,ISTPP<br>,NPHP<br>N(20),JP1,_                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | NT (20,2) , JPH (20,2) , NICHB , NICHB , ISTART , JS , NCASE , NSTNB , LNPHB , LPHB ,                                                                                                                                                                                                                                                                                                                                                                                                                                                           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------------|--------------------------------------------------------------------|
| COMMON / +1TQ (2 +1STOP   +1OPEN   +1OPEN   +NON   +NON   +NOTIN   COMMON   +OMG(20)   +A(9,9)   +OTS   +TLP1(20)   +TLP1(20)   +AE                    | /XCODES/<br>(9),ICOR (2<br>20),ICOP<br>,IPH<br>,IPH<br>,KPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPST<br>,NBOF,IPS                                                                                                                      | 3 PRINT  O), ITI NCNST IFAW ISPH IVAR KQ NEQ IPRINT LB LK2 AB(8), JPRP, J CON(9) GCON(9) GCON(                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | OR CORNER ,INTB ,NSB ,IFAR ,ISST ,JK ,KSY ,NOP ,ISTOP ,GII,MIT,MPI ,TOL1(9,9) ,COT1(9,9) | S,4 RESTAF<br>JGID(20,1)<br>NSAB<br>JEB<br>JAS<br>JAS<br>NAD<br>NPH<br>JISTPP<br>NPHP<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOTE<br>NOT | NT (20,2) , JPH (20,2) , NICHB , NICHB , ISTART , JS , NCASE , NSTNB , LNPHB , LPHB ,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC                             |
| *1TQ (2<br>*1ST (2<br>*1ST (2)<br>*1ST (2)<br>*1ST (2)<br>*1ST (2)<br>*NOP *NOT IN *1FOB | (9),ICOR (2 20) ,ICOP ,IPH ,ITTER ,KPST ,NEOB ,IPST ,IBLK1 ,NBOF ,IL GENF/ ,OTO,ACON(9) ,OTO,ACON(9) ,TIMEPH (2 ,TLS1 (2 ,LIFT ,OV ,LIFTA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | , INTB<br>, NSB<br>, IFAR<br>, ISST<br>, ISST<br>, KST<br>, NOP<br>, ISTOP<br>, MB<br>SII, MTT, MPI<br>, TOL(9)<br>, COT(9)<br>, DPSQ<br>, PA<br>, CSR<br>, TOP<br>, DIP(20)<br>, DIS(20)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | JGID(20,<br>NSAB<br>IFB<br>IARC<br>JPS<br>NAD<br>NPH<br>ISTPP<br>NPHP<br>NC20),JP1,<br>SVAR(10)<br>DCON(9)<br>RO<br>VNR<br>TOS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2), JPH (20,2) , NICHB , IND , ISTART , JS , NCASE , N HB , L HB , NPHB JP2, JP3 , MDC(20) , DTP , QS , CS , CS , SURSQ , TR(9)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | XXCCOOOOOOOONNANANA<br>XXCCOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO      |
| *1TQ (2<br>*1ST (2<br>*1ST (2)<br>*1ST (2)<br>*1ST (2)<br>*1ST (2)<br>*NOP *NOT IN *1FOB | (9),ICOR (2 20) ,ICOP ,IPH ,ITTER ,KPST ,NEOB ,IPST ,IBLK1 ,NBOF ,IL GENF/ ,OTO,ACON(9) ,OTO,ACON(9) ,TIMEPH (2 ,TLS1 (2 ,LIFT ,OV ,LIFTA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   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| ,NSB<br>,IFAR<br>,IFST<br>,JK<br>,KST<br>,NOP<br>,ISTOP<br>,ISTOP<br>,ISTOP<br>,COTI(9)<br>,COTI(9,9)<br>,DPA<br>,CSR<br>,DPA<br>,CSR<br>,DPA<br>,DIP(20)<br>,DIS(20)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | , AILUMB<br>, ISTART<br>, JS<br>, NCASE<br>, NSTNB<br>, LPHB<br>, P2, JP3<br>, WDC(20)<br>, DTP<br>, QS<br>, CS<br>, CSUMSQ<br>, TR(9)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | XXCCOCOOON<br>XXCCCCCCCCCCCCCCCCCCCCCCCCCCC                        |
| *JST (2 *120PEN *110PEN *ITCT *KOP *NOT *IPHNB *IPH                   | ICOP<br>IPH<br>ITER<br>KPST<br>NEOST<br>INBUK1<br>INBUF, IL<br>GENF, OMGP(20,<br>ACON(9),<br>RE<br>PAR<br>ITIMEPH (2),<br>ITET,<br>FOY,<br>LIFT<br>OV,<br>LIFTM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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                                                                 | , NEGR<br>, IPST<br>, IBLK1<br>, NEGF , IL<br>GENF, OMGP(20,<br>, ACON(9),<br>, ACON(9),<br>, PAR<br>, TIMEPH<br>, TPH (2), LIFT<br>, FP<br>, LIFT<br>, CV<br>, LIFT<br>, LIFT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| *NST<br>*1PHNB<br>*1FOB<br>*NCTIN<br>COMMON/6<br>*DMG(20)<br>*A(9,9)<br>*DTS<br>*R<br>*VNU<br>*SVSQ<br>*TLP1(20)<br>*TLP1(20)<br>*AE<br>*AE<br>*AE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | , IPSI<br>, IBBLK1<br>, NB , NEGF , IL<br>GENF/ GOMGP(20,<br>, ACON(9),<br>OT , RE<br>, PAR , TIMEPH<br>, TPH (2<br>, TLS1 (2<br>, LIFT , FP<br>, QV<br>, LIFT M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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| *!PHNB<br>*!FOB<br>*NCTIN N/G<br>*NCTIN COMMON/G<br>*A(9,9)<br>*DTS<br>*R<br>*YNSQ<br>*TST(20)<br>*TIMPR<br>*AE<br>*QE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | GENF/, NEGF , IL GENF/, OMGP(20, ,OT, ,OT, ,PAR ,TIMEPH (2) ,TLS1 (2) ,LIFT ,GV ,LIFTA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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XCOO<br>XCOO<br>XCOO<br>XCOO<br>XCOO<br>XCOO<br>XCOO<br>XCOO       |
| #IFOB<br>*NCTIN<br>COMMON/6<br>*DMG(20)<br>*A(9,9)<br>*DTS<br>*R<br>*VNU<br>*SVSQ<br>*TST(20)<br>*TIPP(20)<br>*TIPP(20)<br>*AE<br>*AE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | NEOF, IL GENF/ OMGP(20) , ACON(9) , OT , RE , PAR , TIMEPH , TPH (2 ), TLS1 , LIFT , QV , LIFTA LIFTM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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XCO<br>SENN<br>SENN<br>SENN<br>SENN<br>SENN<br>SENN<br>SENN<br>SEN |
| *NCTIN COMMON/6 *A(9,9) *A(9,9) *TS* *VNU *SYSQ *TST(20) *TIP1(20) *TIP1* *AE *AE *AE **EE **EE **EE **EE **EE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | GENF/<br>GENF/<br>GENF/<br>GEON(9)<br>,OT<br>,RE<br>,TIMEPH<br>,TIMEPH<br>,TPH (2<br>),TLS1 (2<br>,LIFT<br>,EP<br>,QV<br>,LIFTA<br>LIFTA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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XCO<br>GENN<br>GENN<br>GENN<br>GENN<br>GENN<br>GENN<br>GENN        |
| COMMON/8 *DAG(20) *A(9,9) *DTS *R *VNB *SVSQ *TST(20) *TLP1(20) *TIMPR *AE *AE *LIFTR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | GENFY OMGP(20, OMGP(20, OMGP(20) OMGP(20, OMGP(2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2), VARQ(9),<br>6CON(9),<br>9<br>9 MACH,<br>71 MES<br>0), DIS(20)<br>0), DIP1(20),<br>DRAG,<br>FPOLD,<br>FVAC                                                                                                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 | GEN<br>GEN<br>GEN<br>GEN<br>GEN<br>GEN<br>GEN                      |
| *DMG(20) *A(9,9) *DTS *R *VNU *SVSQ *TLP1(20) *TLP1(20) *TIMPR *AE *AF *LIFTR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | OMEPICO,<br>ACON(9),<br>OT,<br>RE,<br>PAR,<br>TIMEPH (2<br>TIMES),<br>TEN (2<br>TIMES),<br>TEN (2<br>TIMES),<br>TEN (2<br>TIMES),<br>TEN (2<br>TIMES),                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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GEN<br>GEN<br>GEN<br>GEN<br>GEN<br>GEN                             |
| *A(9,9) *DTS *R *VNU *SVSQ *TST(20) *TLP1(20) *TIMPR *AE *AE *UR *LIFTR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ACON(9) OT RE PAR TIMEPH TPH (2) TLS1 (2 TIFT FP OV LIFTA LIFTM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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GEN<br>GEN<br>GEN<br>GEN<br>GEN                                    |
| *015 *R *YNU *SYSQ *TST(20) *TLP1(20) *TIMPR *AE *DR *LIFTR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | , DT<br>, RE<br>, PAR<br>, TIMEPH<br>, TPH (2<br>, LIST (2<br>, LIFT<br>, FP<br>, OV<br>, LIFTA<br>, LIFTM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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ልክሶ                                                                |
| COMMON/S *VAR(14) *XL(9,9) *SINPS1 *SYBV *VDV *UDR *UDR *UDR *GDP *PDO REAL MOP COMMON/S *STN2RM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | , VDM<br>, POP<br>, UDO<br>M , MDV, ADR<br>STATE3/<br>COS2RO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ,COS2SM<br>,XISP<br>,JAER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ,TAULT<br>,JPRO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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, ARC                                                              |
| *****                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | OUR , VDM<br>GDP , POP<br>POO , UDO<br>REAL MOM , MOV, MOR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | UDK , VDR , GDM , MUR<br>GDP , DPP , DPP<br>POO , UDO , HTDV , HTDR<br>REAL MOM , MDV , MDR<br>COMMON/STATE3/<br>SIN/RD , COS2RD , COS2GM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | UOR , VDR , GDM , MGM , PDR , GDP , VDO , VDO , HTOV , HTOR , REAL MDM , MDV , MDR , COS26M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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UOK                                                                |

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```
ARCDAT
ARCDAT
ARCDAT
RETAP
ARCDAT
ARCDAT
GLOBAL
GLOBAL
GLOBAL
GLOBAL
  , MAED
, MXCG
, ZCGR
, RHOB
  MAEE
MZC6
XE
OMULT
   MAEF
MWDA
ZE
REMAX
   , MAEG
, MWDB
, XT
   *MAEB
  76.
778.
79.
80
81.
82
84
85
86
   ≠MT
≠MD8
  *DREF
                                     GLOBAL
   GLOBAL
SETS
STS A DATA
DATA
DATA
PARAM
PARAM
PARAM
PARZINS
   88.
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97.
98.
  100
  101.
102
103
                     ¢
  SW(20), SIZING
SIZING
SIZING
   TURATZ, SIZING
TURATO, SIZING
IPSMAX, SIZING
ISPB, SIZING
SIZING
SIZING
SIZING
SIZING
106.
107
108.
108.
109
110.
111
112.
113
114.
   INITIALIZATION
SPECIAL FLASS USED
K STORAGE RETRIEVAL FLAG =1 NORMAL ,2 PHASE END
3 ARC END, 4 END OF DATA
IND =1 ON STARTING NOMINAL TRAJ.
=2 ON TRIAL OR SOLUTION TRAJ.
KST =0 DURING NORMAL INTEGRATION
=1 DURING NORMAL INTEGRATION
=2 DURING ACC CUT-OFF
=3 OURING CONCURRENT ARC AND PHASE CUT-OFF
ISTART = 1 ON STARTING NOM.
= 2 ON TRIAL
= 6 MEANS CONTROL COMPUTATION DIVERGANCE
OR EXCESSIVE CHANGE IN STAGING TIME
(CAUSES HALVING DOWN)
IOPEN =1 CLOSED LOOP CONTROL
=2 OPEN LOOP CONTROL
   HII
  COAN
COAN
COAN
                     000000000000000000000
   1
116.
117.
118.
   COMM
   COMN
COMN
   COMM
  COMN
COMN
COMN
 121
123
124.
125
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127.
128
129
130.
131
  COMM
COMM
COMM
COMM
COMM
COMM
   COMM
  STT=-RAD
   STT=-RAD
K=1
INIT. FORWARD STORAGE
CALL BEGWR
IND =1
IF(ISTART NE 1) IND=2
CLOSED LOOP FLAG AND SWITCHING TIME SET
IOPEN =1
IOPEN=WORK(1)
IPH =1
   FNT 6
FNT 6
COMN
 133
134
135.
136.
137
  FNTS
FNTS
COMN
137
138.
139
140
141
142.
  FNTS
FNTS
FNTS
   TOPEN=WORK(1)

IPH = 1

IPST = 1

JPS = 1 ABS(JPH(IPH, IND))

ISTPP=JPS-2

ISPH= ISTAN(1, JPH(IPH, IND))

JPS = 0 ABS(IPH, IND)

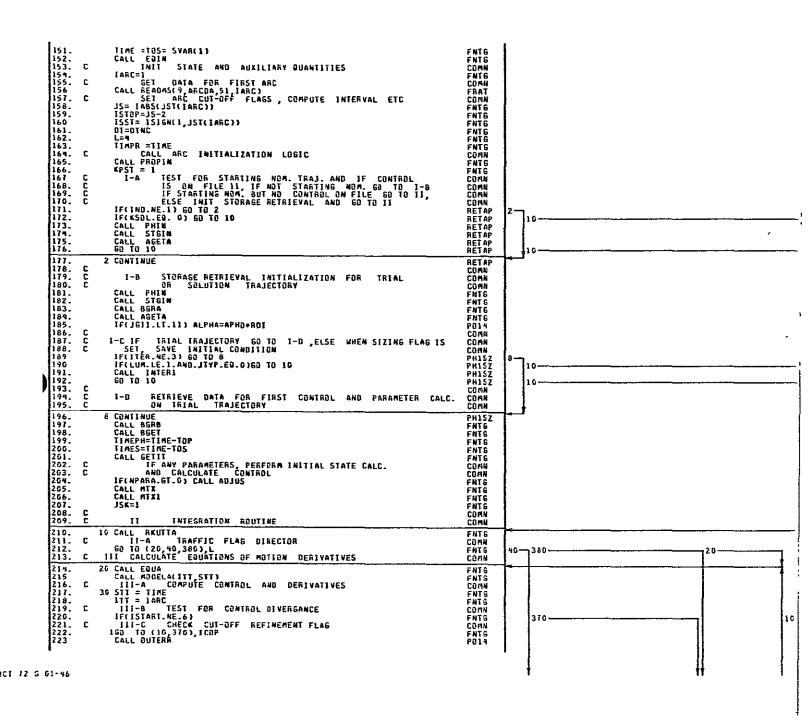
JGII=JGIO(IPH, IND)

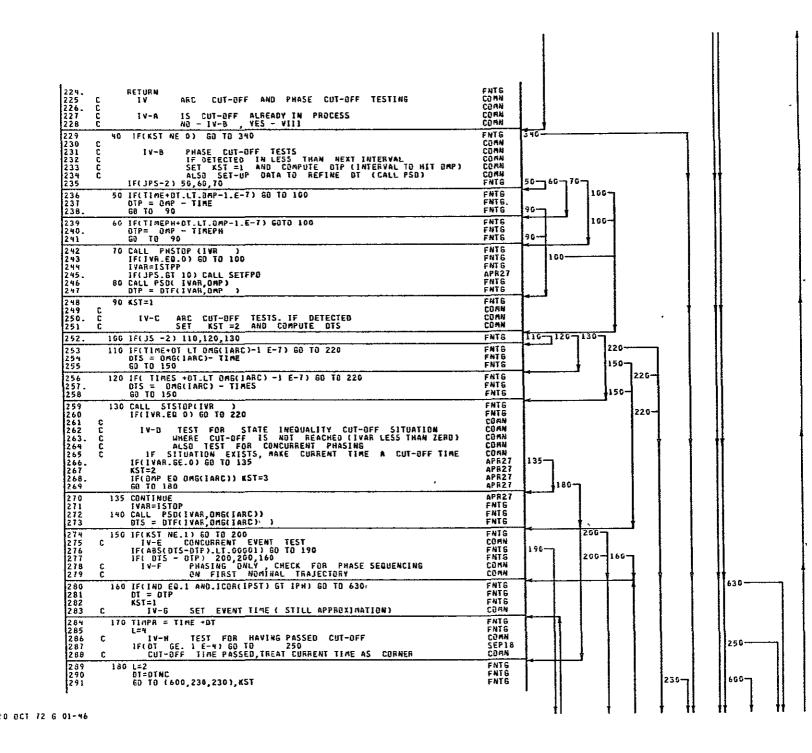
TOP = SVAR(1)

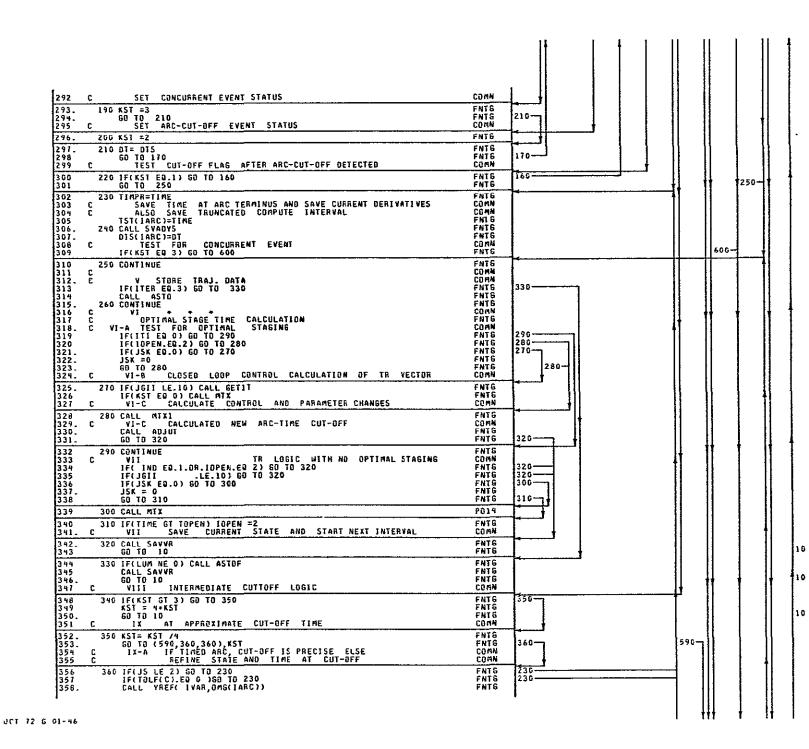
KST = 0

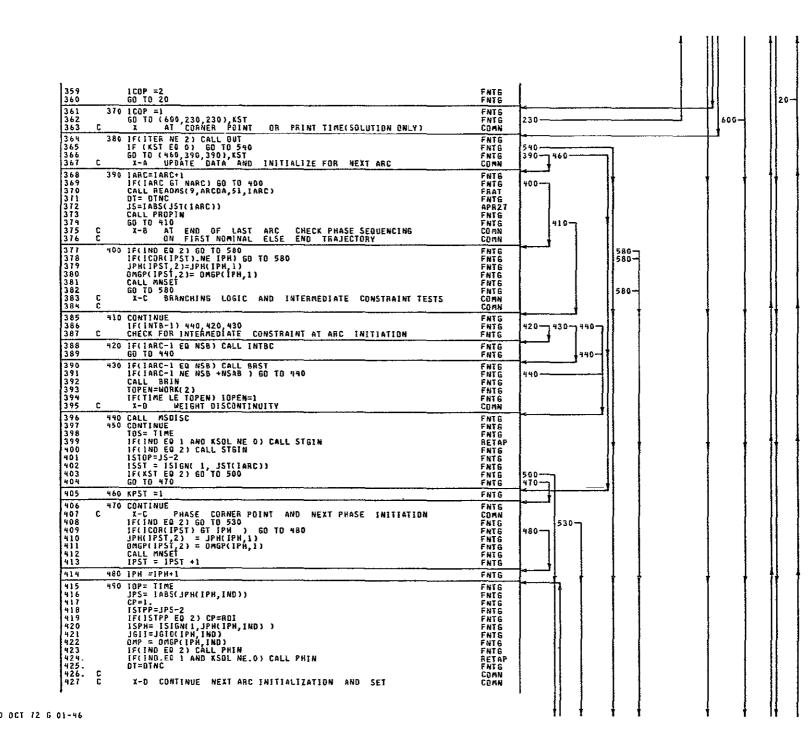
ICOP=1
  FNTS
FNTS
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144.
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|                                                                                            | 11 1 1 1          | E1 2           |
|--------------------------------------------------------------------------------------------|-------------------|----------------|
|                                                                                            |                   | [ ]            |
|                                                                                            |                   |                |
| •                                                                                          | . !! ! ! ! ! ! !  |                |
| 28 C UP TR VECTOR FOR NEXT ARC IF STILL CLOSED LOOP                                        | COMN              |                |
| 29. 5GD KST =0<br>30. TIMPR =TIME                                                          | FNTS              |                |
| 1 L=4<br>32. IF(ITER EQ.3 OR.1ND EQ 1) SO TO 10                                            | FATG              | -              |
| 33. IF(NPA E0.0) 60 TO 510                                                                 | FNT6  510         |                |
| 39. CALL ADJIM<br>35. IF(ITI EQ.O) 60 TO 510                                               | FNTG 510-         | - [[           |
| 36. IF(10PEN EQ 2) 60 TO 10<br>37. 60 TO 520                                               | FNTS 520-         |                |
| 38. 510 IF(IDPEN.EQ.2) 60 TO 10                                                            | FNTG              | - <b>†</b>   - |
| 39 IF(JGII.LE 10) 60 TO 10                                                                 | FNTG              | Ш              |
| 10. 520 CONTINUE<br>11. TIRES=TIRE-TOS                                                     | FNTS<br>FNTG      | - 11           |
| 12. TIMEPH=TIME-TOP<br>13. CALL GETIT                                                      | FNTG FNTG         | - 11           |
| ST. CALL ATX                                                                               | FNTS              |                |
| 15.                                                                                        | FATS ,            | 11             |
| 97. C<br>18. C X-E NEXT PHASE INITIALIZATION                                               | COMM              |                |
| 49. 530 IPH = IPH +1                                                                       | FNTG              | -              |
| 50. 1P5T = IPH<br>51. S0 T0 490                                                            | FNTS 49G-         | Ш              |
| 52 540 IF(11ER NE 3)60 TO 560                                                              | FNTG 560-         | Ш.             |
| 53.                                                                                        | FNTG 550-         | Ш              |
| 55. GO TO 10<br>56. C XI NEW PRINT TIME UPDATE                                             | FNTE<br>CORN      | - []           |
| 57. 550 KPST =0                                                                            | FNTG              | Ш              |
| 58. TIMPR= TIMPR → DTFI+DTNC                                                               | FNTG              | Ш              |
| 59. G0 T0 10<br>60                                                                         | FNTG 570          | - 11           |
| 51. 570 TIMPR = TIME + 1.E6                                                                | FNTS              | 11             |
| 52. KPST =0<br>63 GD TO 10                                                                 | FNTG<br>FNTG      | -              |
| 64. C .                                                                                    | COMM              | Ш              |
| 65 C XII FINAL TRAJECTORY WRAPUP 66. 580 CONTINUE                                          | COMN<br>FNTG      | Ш              |
| 57. NPH=1PST                                                                               | FNTS 1            | 41             |
| 68 TPH(1PST)=TIME<br>59. NST=IARC-1                                                        | FNTG<br>FNTG      | - []           |
| 70. IF(ITER EQ 2) CALL OUT<br>71. IF(ITER.NE.3 AND IPFLG1.EQ.O) CALL PRORPA                | FNTS<br>P014      | 11             |
| 72. CALL ENDWR<br>73. IF(JTYP.GT.O) CALL TRJEND                                            | FNTG -<br>PH1SZ   | Ш              |
| 74. RETURN                                                                                 | FNTS              | - 11           |
| 75 590 IF( JPS LE. 2) 60 TO 600<br>76. C 1x-b Phase Time and State Refinement              | FNT6 60C-         | - 11           |
| 77. IF(TOLPH(C).EQ.O.) 60 TO 600                                                           | FNTG 600-         | II.            |
| 78. CALL YREF( IVAR,OMP)<br>79. ICOP =2                                                    | FNTG<br>FNTG      | []             |
| 90 G0 T0 20                                                                                | FNTG              | 20-            |
| 81. 600 IF(IND EQ 2) 60 TB 610<br>82. C IX-C PHASE TIME IS PRECISE. CHECK PHASE SEQUENCING | FNTG 610-         | Ш              |
| 83. C ON FIRST NOMINAL TRAJ<br>84 IF(ICOR(IPST).GT.IPH)GO TO 620                           | COAN<br>FNTG 620- | 11             |
| 85. 610 TPH(IPST)= TIRE                                                                    | FNTG              | - 11           |
| 86. TIMPRETIME<br>87. DIP(IPST)= DT                                                        | FNTS<br>FNTS      | 11             |
| 88. C                                                                                      | 1 1               | ]              |
| 89                                                                                         | FHTG 250          | 71             |
| 91. GO YO 250                                                                              | FNTG 1250         | }              |
| 92. 630 TIMPR=TIME                                                                         | FNTG<br>FNTG      |                |
| 93. KST=1<br>94. 50 TO 10                                                                  | FNTG 10           | <del></del>    |
| 95 E4D                                                                                     | FNTG              |                |

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# SUBRØUT INE FXDAT

#### Subroutine FXDAT

# Purpose

Subroutine FXDAT fixes floating point numbers in the /ARCDAT/ common block, establishes some presets, and prints the data contained in /ARCDAT/.

# Description

In addition to fixing input option flags and curve numbers, FXDAT also establishes presets if certain critical data has not been input. After this, it prints out the arc data.

FXDAT is called from subroutine GEINP for each set of arc data. The single argument, N is the arc number.

| FURTRAN  | MATH             | CODE DESCRIPTION |                                                            |            | STORAGE |                                                                                                       | SUBROUTINE USAGE |                                                                                      |  |
|----------|------------------|------------------|------------------------------------------------------------|------------|---------|-------------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------|--|
| SYMBOL   | SYMBOL           |                  | DESCRIPTION                                                | BEDEK      | LOC     | SUBR                                                                                                  | CODE             | VAR                                                                                  |  |
| ARCDA    | S <sub>ref</sub> | I                | Aerodynamic reference area (FT <sup>2</sup> )              | /ARCDAT/(  | 1)      | BNTG<br>EQUAS<br>FNTG<br>FXDAT<br>FXDAT<br>GEINP<br>SOINP<br>SIZIN<br>SIZIN<br>THRUS                  | M                | ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCF<br>SREF<br>SREF  |  |
| FRATE    |                  | I                | Input rated vacuum thrust per engine (LBS)                 | /ARCDAT/(  | 42)     | EQUAS<br>FXDAT<br>PROPB<br>PROPIS                                                                     |                  | FRATE<br>FRATE<br>FRATE<br>FRATE<br>FRATE                                            |  |
| 1 AR CDA | S <sub>ref</sub> | 0                | Aerodynamic reference area (FT <sup>2</sup> )              | /ARCDAT/(  | 1)      | BNTG<br>EQUA3<br>FNTG<br>FXDAT<br>FXDAT<br>FXDAT<br>FXDINP<br>SDINP<br>SIZIN<br>SIZIN<br>THRUST<br>VT |                  | ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>SREF<br>SREF |  |
| IATM     |                  | I                | Atmosphere option flag                                     | /ARCDAT/(  | 7)      | EQUAS<br>FXDAT<br>OUT<br>PDBC<br>VT                                                                   | I<br>I<br>I<br>I | MTAI<br>MTAI<br>MTAI<br>MTAI<br>MTAI                                                 |  |
| IMODE    |                  | 門                | Control mode option flag                                   | /ARCDAT/(  | 8)      | FXBAT<br>SDINP                                                                                        | m<br>I           | IMODE<br>IMODE                                                                       |  |
| ĦĬ       |                  | I                | Curve number -thrust table                                 | /ARCDAT/(  | 25)     | FXDAT<br>PROPB<br>PROPIN<br>THRUS                                                                     |                  | MT<br>MT<br>MT<br>MT                                                                 |  |
| N        |                  | 1                | Arc number                                                 | /FXDAT /(+ | . )     | FXDAT                                                                                                 | I                | N                                                                                    |  |
| @muLT    | =0 OR 1          | 0                | Heating flag multiplier                                    | /ARCDAT/(  | 40)     | DER3A<br>FXDAT<br>PDY3A                                                                               | 1<br>0<br>1      | QMULT<br>QMULT<br>QMULT                                                              |  |
| RHOB     | P <sub>b</sub>   | Ô                | Atmosphere base density for heating calculation (LB/FT**3) | /ARCDAT/(  | 39)     | DER3A<br>FXDAT<br>PDY3A                                                                               | 1<br>0<br>1      | RHOB<br>RHOB<br>RHOB                                                                 |  |
| TMULT    | Teult            | M                | Thrust multiplier or number of engines                     | /ARCDAT/(  | 4)      | EQUAS<br>FXDAT<br>PROPB<br>PROPII<br>SIZIN                                                            | N I              | TMULT TMULT TMULT TMULT TMULT                                                        |  |

| SYMBOL | MATH<br>Symbol | COOE     | DESCRIPTION       | BLOCK FOC       | SUBROUTINE<br>SUBR CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------|----------------|----------|-------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| UNO6.  |                | O File o | f all output data | /. UNO 6. / (\$ | BLICOC COORDINATE OF STREET OF STREE | UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066.<br>UN066. |

```
FXDAT
COMN
COMN
COMN
ARCDAT
  SUBROUTINE FXDAT(N)
              1.
2.
3.
4.
5.
7.
8
9.
10.
11.
12.
  0000
   FIXES FLOATING POINT NUMBERS IN ARCDAT (INPUT DATA) AND ESTABLISHES SOME PRESETS ALSO PRINTS DATA
   COMMON/ARCDAT/
+SREF ,EJ
+1ATM ,IMOD
  DTP1
GMAX
MAEA
MAEG
MWDB
XT
   XISP
JAER
GMDOT
MAED
MXCG
ZCGR
RHOB
  TMULT
JPRO
ALFMAX
MAEE
MZCG
   DTNC
QMAX
PHMAX
MAEF
MUDA
ZE
REMAX
  EJ
IMODE
HOMAX
MAEC
MISP
XCGR
MCND
   +XLMAX
   *MAEB
*MT
*MDB
   , XE
, DMULT
   **OREF , MCND , RHOB

** FRATE , ARCD(9)
DIMENSION ARCDA(40)
EQUIVALENCE(SREF, ARCDA)
DIMENSION IARCDA(1)
EQUIVALENCE (IARCDA, ARCDA)
DO 10 1=7,10

DO 20 I=18,31
20 IARCDA(1)=ARCDA(1)
IARCDA(1)=ARCDA(38)
IF(IATM-1) 30,40,50
62 STANDARD
30 RHOR = 23769054F=3
   + DREF
              14.
15.
16.
17.
18
19
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23.
24
   ARCDAT
ARCDAT
FXDAT
   FXDAT
FXDAT
FXDAT
FXDAT
Ц
d
  FYDAT
  FXDAT
FXDAT
   30-140-
  FXDAT
              26
27.
28.
  30 RHOB = 2 3769054E-3
60 TO 60
63 PAT
   FXDAT
FXDAT
  60-
  FXDAT
              29
30.
  40 RHOB = 2 2964063E-3
60 TO 60
   FXRAT
  60.
  FXDAT
  50 QMULT=0.
RHOB =1.
              31
                32
  FXDAT
               33
34
35
   60 CONTINUE
IF(TMULT GT.O.) 60 TO 65
IF(FRATE GT.O.GR.MT NE.O) TMULT =1
  FXDAT
FRAT
  65.
  FRAT
  FRAT
FRAT
FXDAT
              36
37.
                FXDAT
   FYDAT
  RETURN 70 FORMAT(//17H DATA FOR SUBARCI3 / 5%,5HSREF=E12.6,4%,9HNDZ.AREA=E1 FXDAT 12 6,9%,4HISP=F7 3,9%,9HTH MULT=F5 2,12%,8HOELTA T=F9.5/ FXDAT 210H PRT MULT=F5.1,11%,9HATM OPTN=12,14%,9HCNT.MODE=13,13%,9HAER OP FXDAT XIN=13,13%,9HPRO OPTN=13/5%,5HOMAX=F6 3, APR27 410%,9HMAX*LIFT=E12.6, 5%.8HHEAT FXDAT 5%.8HHEAT FXDAT 5%.8HHEAT FXDAT
   FXDAT

5 RT=E12.6,7%,6HGHDOT=E13.6/3%,7HALFMAX=F7.3,11%,7HPHIMAX=,F7.3

7,11%,7HXCGREF=F8.3,10%,7HZCGREF=F7.3,11%,5HXENG=F8.3/

* 5X,8HHEAT

FXDAT

7,11%,7HXCGREF=F8.3,10%,7HALFMAX=F7.3,11%,7HPHIMAX=,F7.3

PD14

FXDAT

   FXDAT
```

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# SUBRØUT I NE GET I T

#### Subroutine GETIT

Entry Points. STGIN, PHIN

## Purpose

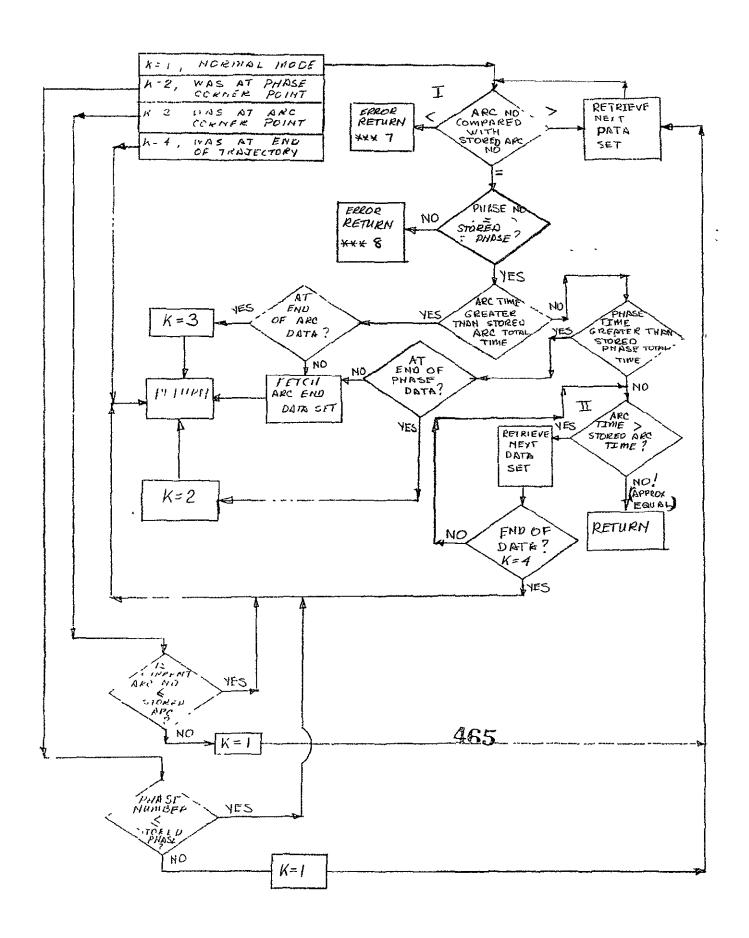
GETIT controls trajectory and adjoint data fetching during forward trial trajectory integration.

### Description

GETIT retrieves data by calling subroutines AGETA and BGET. The main intent of the logic in this routine is to retrieve data from the adjoint and old nominal trajectory at as near the current arc time as possible. (Arc time rather than elapsed time is the independent variable in the program). No data interpolation is done.

Entry points STGIN and PHIN are called by FNTG at the beginning of each arc and phase respectively to locally define total arc and phase durations.

GETIT is called by MODELA.



| FORTRAN<br>Symbol | MATH<br>Symbol   | CODE DESCRIPTION                                                                                   | STORAGE<br>BLOCK LOC | SUBROUTINE USAGE<br>SUBR LODE VAR                                                                                                                                                                                              |
|-------------------|------------------|----------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DDT<br>D1P1       |                  | W Difference between stored and current arc time 1 Phase initial times for nominal trajectory [sd] |                      | GETIT W ODT OFFIT I OIPL SOINP M OIPL TEST O DIPL TOPM I OIPL                                                                                                                                                                  |
| 0151              |                  | 1 Arc Initial times for nominal trajectory [sd]                                                    | /GENF /( 473)        | GETIT I DISI SDINP M DISI TEST O DISI TOPM I DISI TRANS I DISI                                                                                                                                                                 |
| DPHT<br>BST       | 7 <sub>OLD</sub> | W Stored phase duration<br>W Stored arc duration                                                   |                      | GETIT W DPHT<br>GETIT W DST                                                                                                                                                                                                    |
| FTIME             | OLD.             | I Time at phich trajectory data set is stored.<br>(SE                                              |                      | AGETB3 O FTIME AST3 O FTIME GETIT I FTIME TRAN3 I FTIME                                                                                                                                                                        |
| JARC              | ÷                | I Arc number                                                                                       | /XCODES/( 146        | ADICB3 I IARC ADID3A I IARC ADID3A I IARC ADJUST I IARC AST3 I IARC BNTG M IARC ENVPRM I IARC FNTG M IARC GETIT I IARC MODELA I IARC PROPB I IARC PROPB I IARC PROPIN I IARC STP3 I IARC STP3 I IARC STP3 I IARC TRTOSZ I IARC |
| IPH               |                  | Į Phase number                                                                                     | /XCODES/( 143)       | ADID3A I IPH ADJUST I IPH AST3 I IPH BNTG M IPH FNTG M IPH GETIT I IPH GUI3A I IPH SOINP M IPH                                                                                                                                 |
| IPHN              |                  | I Stored history data phase number                                                                 | /XCODES/( 170)       | AGETB3 M IPHN<br>AST3 M IPHN<br>GETIT I IPHN                                                                                                                                                                                   |
| ISTN              | •                | I Stored history data arc number                                                                   | /XCODES/( 169)       | ) AGETB3 0 ISTN<br>AST3 0 ISTN<br>GETIT I ISTN<br>TRAN3 I ISTN                                                                                                                                                                 |
| ITER              |                  | I Trajectory pass indicator. ITER = 1, CONSTRAINTS = 2, OPTIMIZATION = 3, SOLUTION                 | /XCODES/( 149        | AST3 I ITER FNTG I ITER FNTG I ITER GETIT I ITER MODELA I ITER PAYO2 M ITER PROPIN I ITER TEST M ITER TOPM M ITER                                                                                                              |
| K                 |                  | M Storage retrieval flag indicates end of arc, phas or data.                                       | e, /XCODES/( 156     | AST3 0 K FNTG 0 K GETIT M K MODELA I K SDINP M K                                                                                                                                                                               |
| TIMEPH            | γ <sub>p</sub>   | I Phase time (SE                                                                                   | C) /GENF /( 318      | D EQUAS O TIMEPH<br>FNTG M TIMEPH<br>GETIT I TIMEPH<br>GUISA I TIMEPH<br>OUT I TIMEPH                                                                                                                                          |

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE         | DESCRIPTION                  |       | S TI<br>BLOCK | DRAG | E<br>LOC | SUBRÛL<br>SUBR                                                      |                       | U5AGE<br>VAR                                                   |
|-------------------|----------------|--------------|------------------------------|-------|---------------|------|----------|---------------------------------------------------------------------|-----------------------|----------------------------------------------------------------|
| TIMES             | 7              | 1 Arc time   |                              | (SEC) | /GENF         | /(   | 319)     | AST3<br>EQUA3<br>FNTG<br>GETIT<br>OUT                               | I<br>0<br>M<br>I      | TIMES<br>TIMES<br>TIMES<br>TIMES<br>TIMES                      |
| TMS               |                | W Stored cur | rent arc time                |       | /GETIT        | /(+  | )        | GETIT                                                               | W                     | TMS                                                            |
| TPHI              |                | I Phase end  | times for nominal trajectory |       | /GENF         |      | 413)     | BNTG<br>GETIT<br>SDINP<br>TEST<br>TOPM                              | I<br>I<br>0<br>0<br>1 | TPH1<br>TPH1<br>TPH1<br>TPH1<br>TPH1                           |
| TST1              |                | 1 Arc end ti | wes for nominal trajectory   |       | /GENF         | /(   | 433)     | BNTG<br>GETIT<br>PROPIS<br>SDINP<br>TEST<br>TOPM<br>TRAN3<br>TRTOSZ | 0<br>0<br>1<br>1      | TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST-1<br>TST-1 |

GETIT

```
SETIT
COMM
COMM
COMM
  SUBROUTINE GETIT
   CONTROLS STORAGE FETCHING FOR FORWARD TRAJECTORY
K IS THE KEY FLAG
K=1 NORMAL PROGRESSION
K=2 HUNG UP AT PHASE END POINT
K=3 HUNG UP AT ARC END POINT
K=4 AT END OF STORED DATA
  CORN
  CORN
CORN
CORN
CORN
FETREV
  COMMON/RETREY/ FTIME, BTIME, MAXA(2), MAXB
COMMON/RETREY/
**NBUFEA(2), IBUF1 , IBUF2 , NBFA
**MIXB , MXA , MXB , NPTA
**MBUFB | IBUFB |
COMMON / SCODES/
**ITQ (9), ICOR (20), ITI , INTB
JST (20) , NCNST , NSB
**IZOP , ICOP , IFAH , IFAR
   RETREV
RETREV
RETREV
RETREV
   123456711190122222222223333334567
  , NBFB
  INTB
NSB
IFAR
ISST
3K
KST
NOP
ISTOP
  JGID(20,2), JPH (2G,2),
NSAB NICNB
, IFB IND
, IARC ISTART
, JPS JS
, NAD NCASE ,
NPH N
, IFHN ISTABB ,
1STABB ,
1STAB ,
NPH NPHB ,
NPHP NPHB ,
NPHP NPHB ,
1P3 1P3 1P3
   ,ITI
,NCMST
,IFAH
,ISPH
,IVAR
,K
,NEQ
,IPRINT
,IBLK2
  ,1COP
,IPH
,ITER
,KPST
,NEOB
,IPST
,IBLK1
   *IOPEN
*ITCT
*KOP
*NCH
   *NST
*IPHNB
*IFOB
*NCTIN
  MB
   3611,MTT,MPIN(20),JP1,JP2,JP3
   TOL(9), PA
COTI(9, 9), DPSQ
PA
CSR
TOP
OIS1(20), OIS1(20),
TAX
FPD
FPD
LIFTY
DRAGY
  , UDC( 20 )
DTP
, DS
, CS
, SUMSD
, TR( 9 )
, M
, DMP
, TBU( 20 )
  DCON( 9)
  , VAR
, TOS
   TIME
TBURN
   HACHR
   MACHY
   334444444444555555555556
  ORAGR
JSP
JULFTR
JMCSM
DELTAE
  DRAGA
ISPF
ULFTA
CODAE
,SID
  DBR
ULFT
XMCGR
CALPHA
XCG
  , ULFTV
, XMCGA
, CDE
, ZCG
  GENTER SEENS GENTE
   ,XMCGV
,CT
,SIDAE
GENF /
  *XMCG
   +CULFT
+COD
COMMON
+XJV
   GENF /
XJR
, IRATED
  , XKP
   , GH
   , SARRAD
   , XKS
   *FRATED
  XK1
XK10
XK1V
XK1P
XK10
XK1M
PR
  , XK2
, XK2D
, XK2V
, XK2P
, XK20
, XK2M
, PO
   ,xk3
,xk3D
,xk3V
,xk3P
,xk3B
,xk3M
,pdy(3,8)
  MACH, MÁČHĀ,
  FRAT
GENF
GENF
  GETIT
   10-
  160-
   110-120-
  ST. STORED ARC NUMBER
  CORN
   61
   10 IF( IARC- ISTN) 140,30,20
  30-
   207
   GETIT
  140-
   62
63
64
65
   20 CONTINUE
CALL AGETA
IF (ITER NE 3) CALL BEET
GO TO 10
   GETIT
GETIT
  GETIT
   30 IF( IPH NE IPHN) GO TO 150
IF ( TIMES.GT. DST) GO TO SO
IF ( TIMEPH.GT DPHT) GO TOBO
II LOOP IF CURRENT ARC TIME GT STORE ARC TIME
   66
67
68
69
  GETIT
GETIT
GETIT
COMN
  150-
  50-
   80-
   40 TMS=FTIME-ISTI(IARC)
00T=TIMES-TMS
IF(ABS(0DT) LE.1.E-3) SO TO 130
IF(0DT.LT 1.E-5) SO TO 130
   76
71.
72
73.
   GETIT
GETIT
GETIT
GETIT
  130
130
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```

468

```
CALL AGETA
IF(ITER NE 3) CALL BGET
II-A STOP SEARCH IF END OF STORED DATA
IF(K EQ.4) GO TO 130
GD TO 40
   GETIT
GETIT
COMN
GETIT
GETIT
  74
75
76
77
78
            C
   130
   40-
                   50 1F(IMS GE DST) GO TO 70

11-B STOP LOOP IF ARC TIME GREATER THAN STORED ARC

DURATION (SET N=3)
  79
80.
81
  SETIT
COMN
COMN
  70-
                   60 CALL AGETA
IF(ITER NE.3) CALL BGET
IMS=FTIME-TST1(IARC)
G0 T0 130
  82
83
84
85
  GETIT
GETIT
GETIT
  GETIT
   130-
                   TO K=3
GO TO 130
III STOP IF PHASE TIME GT STORED PHASE DURATION

80 TMP=FTIME-TPH1(IPH)
IF(IMP.GE DPHT) GO TO 90
GO TO 60
  GETIT
GETIT
COMN
  86
87.
  130
  88
  89.
90
91
  GETIT
GETIT
GETIT
   90-
  92
93
                   90 K=2
GO TO 130
  GETIT
GETIT
  130
  94
95.
96
                 100 IF(IPH LE IPHN) 60 TO 130
K =1
GO TO 20
  GETIT
GETIT
GETIT
  130
                 110 IF(IARC.LE ISTN) 60 TO 130 K=1 GO TO 20
  97
98
99
  GETIT
GETIT
  130-
  20-
 160
                 120 CONTINUE
  GETIT
   GETIT
COMN
COMN
COMN
COMN
SETIT
SETIT
GETIT
GETIT
GETIT
101
102.
103.
104
105
106
107.
108
109
                 130 RETURN
                          RETURN

IV

ENTRY POINTS SET-UP ARC AND PHASE DURATIONS
FROM STORED DATA TO CORRESPOND TO CURRENT
ARC AND PHASE
ENTRY STGIN
DST = DISI(IARC) - TSTI(IARC)
RETURN
ENTRY PHIN
DPHT = DIPI(IPH) - TPHI(IPH)
RETURN
             0000
112.
113
114
115
                 140 CONTINUE
CALL DUT
IF(1COP NE 2) CALL STPIT(7)
GO TO 160
  GETIT
GETIT
GETIT
GETIT
   160-
                  150 CALL STPIT(8)
116
  GETIT
                 160 RETURN
END
117
  GETIT
```

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## SUBRØUT I NE GUI3A

#### Subroutine GUI3A

#### Entry Point, GUID

#### Purpose

GUI3A computes simple nonoptimal control for steepest descent starting solution.

#### Description

The local option flag JGII determines which control calculation is used. This routine is called from MODELA.

| ORTRAN       | MAIH   | CONE  | DESCRIPTION                                        |             | STORA     |      | SUBBOUTINE                                                                                         |                                                              |
|--------------|--------|-------|----------------------------------------------------|-------------|-----------|------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| PAMBOL       | SYMBOL | 10116 | DESCRIFTION                                        | <del></del> | BLOCK     | LOC  | 2098 CODE                                                                                          | VAR                                                          |
| АРНЯ         | α      | ញ     | Angle of attack                                    | (DEG)       | /AECD3 /( | 21   | AGETB3 D<br>AST3 M<br>BEROCCD I<br>BLGCON O<br>GUI3A M<br>MODELA M<br>MODELB I<br>MTX3A D<br>OUT I | APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR |
| COSPHI       | ¢os∳   | M     | See symbol                                         |             | /AEC03 /( | 13)  | ACCEL I<br>BL4 I<br>GUI3A M<br>MODELA M<br>MODELB M<br>OUT I                                       | COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI     |
| GAM          | 7      | I     | Relative flight path angle                         | (RAD)       | /STATE3/( | 2)   | EQUA3 I<br>GUI3A I<br>OUT I                                                                        | GAM<br>GAM<br>GAM                                            |
| IND          |        | 1     | Flag indicates whether on first nominal tr (IND=1) | ajectory    | /XC00ES/( | 141) | AST3 I<br>BGET3 I<br>FNTG M<br>GUI3A I<br>MTX3A I<br>PROPIN I                                      | ON I<br>ON I<br>ON I<br>ON I<br>ON I<br>ON I                 |
| IPH          |        | I     | Phase number                                       |             | /XCODES/( | 143) | ADID3A I<br>ADJUST I<br>AST3 I<br>BNTG M<br>FNTG M<br>GETIT I<br>GUI3A I<br>SDINP M                | IPH<br>IPH<br>IPH<br>IPH<br>IPH<br>IPH<br>IPH<br>IPH         |
| 1957         |        | 1     | Phase counter for first nowinal trajectory         |             | /XCODES/( | 167) | AST3 I<br>FNTG M<br>GUI3A I<br>REU3 I                                                              | IPST<br>IPST<br>IPST<br>IPST                                 |
| <b>J</b> 611 |        | I     | Control option                                     |             | /xcodes/( | 195) | ACCEL I<br>BNTG O<br>DER3A I<br>FNTG M<br>GUI3A I<br>MODELA I<br>MODELB I<br>MTX3A I<br>PDY3A I    | J611<br>J611<br>J611<br>J611<br>J611<br>J611<br>J611         |
| MNGA         |        | M     | Control history curve number                       |             | /STS /(   | 32)  | GUI3A M<br>SDINP M<br>SDINP I                                                                      | MNGA<br>MNGA<br>Tal                                          |
| MNGP         |        | M     | Control history curve number                       |             | /ST\$ /(  | 72)  | GUI3A M<br>SDINP M<br>SDINP I                                                                      | MNGP<br>MNGP<br>WTP I                                        |
| PHID         | φ      | m     | Bank angle                                         | (086)       | /AEC03 /( | 10)  | AST3 M                                                                                             | PHID<br>PHID<br>PHID<br>PHID<br>PHID<br>PHID<br>PHID         |
| PHIR         | φ      | M     | Bank angle                                         | (RAD)       | /AEC03 /( | 11)  | GUI3A M<br>MODELA M<br>MODELB M<br>OUT I                                                           | PHIR<br>PHI<br>PHI<br>PHI                                    |
| PSI          | *      | I     | Azımuth                                            |             | /STATE3/( | 5)   | EQUA3 I<br>GUI3A I<br>OUT I                                                                        | PSI<br>PSI<br>PSI                                            |

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| EDRIKAN<br>SYMBOL | #14#<br>54#80£ | LODE | DESCRIPTION                              |       | \$1.<br>BUULK | 0 H A Si | rgr  | <u> 5 UBROU</u><br>5 UBR                                                                                   |                                       | F USAGE<br>E VAR                                             |
|-------------------|----------------|------|------------------------------------------|-------|---------------|----------|------|------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------------------|
| RAD               |                | 1    | Radian to angle conversion, 57.29577951  |       | /DATA         | /(       | 2)   | BEROCO<br>BLGCON<br>ENVPRM<br>EQUA3<br>FNTG<br>GUI3A<br>MODELA<br>MTX3A<br>OUT<br>PADS1<br>SBINP<br>TRTOSZ | I I I I I I I I I I I I I I I I I I I | DEG BADD RADD RADD RADD RADD RADD RADD RADD                  |
| ICA               |                | 1    | Angle to radian conversion, .01745329252 |       | /DATA         | /(       | 3)   | BLICO<br>DERSA<br>FNTG<br>GUISA<br>MODELB<br>PADSI<br>PROPB<br>PROPIN<br>REUS<br>SOMG                      | I<br>I<br>I<br>I<br>I<br>I<br>I       | ROI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI  |
| SINA              | sîn∝           | М    | See symbol                               |       | /AEC03        | 70       | 7)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BLB<br>FH3<br>GUI3A<br>OUT<br>VT                                             | I<br>I<br>I<br>I<br>M<br>I<br>M       | SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA |
| THL               |                | 1    | Steering arrouth attitude.               | (DEG) | /GUI3A        | /(*      | )    | GUI3A                                                                                                      | I                                     | THL                                                          |
| THLR              | 8 <sub>i</sub> | ដ    | Steering azimuth attitude.               | (RAD) | /GU13A        | /(*      | )    | GUI3A                                                                                                      | W                                     | THLR                                                         |
| THP               |                | I    | Steering pitch attitude.                 | (DEG) | /GU13A        | /(*      | )    | GUI3A                                                                                                      | 1                                     | THP                                                          |
| THPR              | Ø <sub>p</sub> | u    | Steering pitch attitude.                 | (RAD) | /GUI3A        | /(*      | >    | GUI3A                                                                                                      | W                                     | THPR                                                         |
| TIMEPH            | τ <sub>p</sub> | I    | Phase time                               | (SEC) | /GENF         | /(       | 318) | EQUAS<br>FNTG<br>GETIT<br>GUISA<br>OUT                                                                     | 0<br>I<br>I<br>I                      | TIMEPI<br>TIMEPI<br>TIMEPI<br>TIMEPI<br>TIMEPI               |

```
GUI3A
COMN
COMN
GENF
   SUBROUTINE GUISA
      1.23456789
  Ç
   TOUTICE TOUTIC
   WDC(20)
DTP
QS
CS
SUMSQ
TR(9)
H
OMP
TBU(20)
MACHY
  ,SVAR(10)
  , BC, GC, MACH, MOR, TIMES (20), DIS(20), DRAS , FPOLD , FVAC , DBR
  RO
VAR
TOS
   TIME
TBURN
MACHR
  DRAGR
ISP
ULFTR
XMCGM
DELTAE
   DRAGA
ISPF
ULFTA
CODAE
,SID
   DBR
ULFT
XMCGR
CALPHA
XCG
  XMCGV
CT
SIDAE
GÉNF /
XJR
IRATEO
  2222222222233333333334444444444
  , GAMMAD
   , XKS
  , XKP
   XK1
, XK1D
, XK1V
, XK1P
, XK1D
, XK1M
, PR
   , XK2
, XK2D
, XK2V
, XK2P
, XK2O
, XK2M
, PO
  , XK3
, XK30
, XK3V
, XK3P
, XK30
, XK30
, XK30
, XK30
   GENF
FRAT
GENF
   MACH,
  MÁCHR,
  SENF
  (20),ITI
,NCNST
,IFAW
,ISPH
,IVAR
,K
,NEQ
   ,INTB
,HSB
,IFAR
,ISST
,JK
,KST
,NOP
,ISTN
,ISTOP
  +1T0
+JST
+120P
+10PEN
  ICOP
IPH
ITER
KPSTB
IPST
IPST
INBUT
INBUT
   *IOPEN
*ITCT
*KOP
*NCN
*HST
*IPHNB
*IFOB
*NCTIN
   , IPRINT
  , LB
ILAB(8), JPRP
  *NCTIN NEGF ILAB(8)
COMMON/ARCDAT/
*SREF EJ
*IATH IMODE 34
*XLMAX HUMAX GF
*MAEB MAEC MA
*MT MISP AY
*MDB XCGR ZCG
*DREF MCMD RH
*FRATE ARCD(9)
DIMENSION ARCDA(40)
EQUIVALENCE(SREF, ARCDA)
COMMON/DATA/
*PI RAD RO
*FTNH CAR JG
*COMMON/STS/
*OPAY PMIN NO
   JGÍÍ, MTT, MPIN(20), JPI
8901234567890123456789012345
  ,XISP
,JAER
,GMDOT
,MAED
,MXCS
   THULT
   JPRO
ALFMAX
MAEE
MZCS
XE
   ZCGR
   , A HOB
   DHULT
   ARCDAT
DATA
DATA
DATA
   ,TAPF
,JOP9
   ,SC
,JOP2
   ,UMF
,JOP3
  DAIA
STS
STS
SIS
GLOBAL
GLOBAL
GLOBAL
GLOBAL
  GLOBAL
GLOBAL
RETAP
STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
  IPFLG2, IPFLG3, IPFLG4, INEQFL(20)
   ,544(10)
,SAVBP(15)
,OCORO2
   ,YO(9)
,SINGAM
,OCORMO
```

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| 76.<br>77<br>78. | * 4 D A<br>* 11 D A<br>* 11 D B | , 406<br>, 406<br>, 408               | ROV<br>GDG<br>GDA                       | , MDV<br>, RDG<br>, MDR                  | PDV<br>PDG<br>PDR | ,00V<br>,00G<br>,00R<br>,VDP | ;   | STATE30<br>STATE30<br>STATE3D<br>STATE3D |                           |     |
|------------------|---------------------------------|---------------------------------------|-----------------------------------------|------------------------------------------|-------------------|------------------------------|-----|------------------------------------------|---------------------------|-----|
| 79<br>80         | #UDR<br>#GDP                    | , VOA<br>, POP                        | , 69M<br>, 00P                          | , MDM<br>, VDP                           | , PDM<br>, VDO    | , GDO                        | •   | STATE3D                                  |                           |     |
| ĕĭ               | *PDO                            | . ບໍ່ດີວ່                             | , HT DV                                 | HTDR                                     | ,                 | ,                            | ,   | STATE30                                  |                           |     |
| 82               | REAL MDM                        |                                       | l *****                                 | • =                                      |                   |                              |     | STATE30                                  |                           |     |
| 83.              | COMMON/S                        |                                       |                                         |                                          |                   |                              |     | STATESD                                  |                           |     |
| 84.              | *SIN2RO                         | , COSZRO<br>NCÉ (VAR(1<br>PSI), (VAR( | COSZGM                                  | A                                        | ALT.              | / UAD/ 4 \ M \               |     | STATE3D<br>EQUV3                         |                           |     |
| 85<br>86         | FARIANTE                        | NUE (VAH(1                            | ), Y ) , ( YAK(                         | 2),6AM) ,(V:<br>5/7/ Mil/ / U            | AK(3), ALIJ       | ,( YAK( 3), N)               | 25  | EDUA3                                    |                           |     |
| 87.              | #( DVAR( 1)                     | ND) (DVAR                             | 21.681.(07                              | 2),6AM),(V<br>R(7),MU),(V<br>AR(3),HD),( | TVAR(4) MD        | . ( DYAR(5).P                | Ōì. | EQUV3                                    |                           |     |
| 88               | *( DVAR( 6 )                    | .OD) COVAR                            | 71.UB1.(DV                              | AR(8), HTD),                             | DVAR(9).50        | 2D)                          | ,   | EQUV3                                    |                           |     |
| 89               | REAL M, M                       | U,MD                                  | , , , , , , , , , , , , , , , , , , , , |                                          | •                 |                              |     | EDUV3                                    |                           |     |
| 90               | COMMON/A                        | ECB3/                                 | ALDUA                                   | ND 6                                     | CDA               | 206                          |     | AEC03                                    |                           |     |
| 91<br>92.        | ≠APHO<br>≠SINA                  | APHR<br>COSA                          | ,ALPHA<br>,PHIO                         | ,VDA<br>,PHID                            | , GDA<br>, PHI    | ,PDA<br>STNEUT               | ,   | AECO3<br>AECO3                           | i                         |     |
| 93.              | *COSPHI                         | , GDPH                                | PRPH                                    | YI AMALY                                 | XLAMP(9           | SINPHI<br>CDO                | ,   | AEC03                                    |                           |     |
| 94.              | *CD0M                           | . Cl.O                                | _ F X                                   | XESS                                     | . ZCGM            | LCLOP                        | ,   | AEC03                                    |                           |     |
| 95.              | +CA                             | , UPA                                 | 1:669 (:                                | MM LUNG                                  | , Cmom            | FXA                          | ,   | AEC03                                    |                           |     |
| 96               | <b>÷CLAM</b>                    | .CL                                   | , CLA                                   | ELM                                      | ,                 | •                            |     | AECO3                                    |                           |     |
| 97               | *CD                             | CDA                                   | CDA                                     |                                          |                   |                              |     | AECD3                                    |                           |     |
| 98               | ENTRY 6U                        | NCE (PHIR,                            | TA1 )                                   |                                          |                   |                              |     | 10                                       | ľ                         |     |
| 100              | 60 TO (1                        | 0.20.903.1                            | ai i                                    |                                          |                   |                              |     | GUI3A                                    | 1020-                     | 791 |
| 101 C            | I AF                            | 0,20,90),J                            | AID FUNCTI                              | ONS OF PHA                               | SE TIME           |                              |     | COMN                                     |                           | 1   |
| 102              | 10 CALL TBL                     |                                       |                                         | H APKS)                                  |                   |                              |     | 6UI3A                                    | <b></b>                   |     |
| 103              | CALL TBL                        | KI MNGPL IPH                          | IND), TIMEP                             | H.PHID)                                  |                   |                              |     | SUI3A                                    | I                         | 1   |
| 104.             | RETURN                          |                                       |                                         | • · · · · · · ·                          |                   |                              |     | GUISA                                    | ļ                         | ]   |
| 105 C            |                                 |                                       |                                         |                                          |                   |                              |     | COMM                                     |                           | I   |
| 106 C            | II PI                           | TCH AND YA                            | # STEERING                              | ATTITUDES                                |                   |                              |     | COMN                                     | L                         | t   |
| 107              | 20 CALL TBL                     | K(MNGA(IPH                            | , IND), TIMEP                           | H, THP)                                  |                   | •                            |     | GUI3A                                    |                           | -   |
| 108              | CALL TBL                        | .K(MNGP(IPH                           | ,IND),TIMEP                             | H,THL)                                   |                   |                              |     | GUIJA                                    | l                         |     |
| 109              | THPR =TI                        |                                       |                                         |                                          |                   |                              |     | GUI3A<br>GUI3A                           | i                         |     |
| 110              | THLR =T:                        | ITB - BZI                             |                                         |                                          |                   |                              |     | GUISA                                    | į                         |     |
| iiż              | ALP = Th                        | PR - GAM                              |                                         |                                          |                   |                              |     | GUIJA                                    | ĺ                         |     |
| 113              | IF(ALL.E                        | 0 0.) 60                              | 10 60                                   |                                          |                   |                              |     | GUIJA                                    | 60                        | ~   |
| 114              | IF(ALP E                        | 0.) 60                                | TO 70                                   |                                          |                   |                              |     | GU13A                                    | l                         | - 1 |
| 115              | SALL = S                        | IH(ALL)                               |                                         |                                          |                   |                              |     | GUI3A                                    | Ì                         | - 1 |
| 116              | SALP = S                        | IN(ALP)                               | PALDS                                   |                                          |                   |                              |     | GUI3A                                    | ł                         | ı   |
| 118.             | CUZBAT=1                        | ANZ( SALL,                            | DHLP /                                  |                                          |                   |                              |     | GU13A                                    |                           | - 1 |
| 119.             |                                 | LP/COSPHI                             |                                         |                                          |                   |                              |     | GUIJA                                    | l                         | - 1 |
|                  | IF(ABS(S                        | INA).GT.1.                            | ) SINA=.999                             | 999999                                   |                   |                              |     | GUI3A                                    | ì                         | - 1 |
| 120<br>121       | APHR = 1                        | ibscasincsi                           | NA)) +RAD                               |                                          |                   |                              |     | GU13A                                    | l                         | - 1 |
| 122              |                                 | IIR + RAD                             | TO 05                                   |                                          |                   |                              |     | SUIJA                                    | 20                        | ŧ   |
| 123.             |                                 | GT.90.) 50                            |                                         |                                          |                   |                              |     | GUISA                                    | 30 40.                    | _   |
| 124<br>125       | RETURN                          | LT90.) 6                              | u 10 10                                 |                                          |                   |                              |     | GUI3A<br>GUI3A                           | ا ا                       | Н   |
|                  |                                 | D 100                                 |                                         |                                          |                   |                              |     |                                          | <del> </del> <sup>™</sup> | 11  |
| 126<br>127       | 30 PHID=PHI<br>60 TD !          |                                       |                                         |                                          |                   |                              |     | 6013A<br>6013A                           | 50-                       | П   |
|                  |                                 |                                       |                                         |                                          |                   |                              |     |                                          | <del> </del>              | 니   |
| 128.             | 40 PHID=186                     |                                       |                                         |                                          |                   |                              |     | GUI3A                                    | لــا                      | ŀ   |
| 129              | 50 APHR=-A                      | HR                                    |                                         |                                          |                   |                              |     | GUISA                                    | 1                         | Į   |
| 130              | RETURN                          |                                       |                                         |                                          |                   |                              |     | GU134                                    | <b>L</b>                  | ţ   |
| 131              | 60 CONTINU                      |                                       |                                         |                                          |                   |                              |     | GUISA                                    | Γ                         |     |
| 132.             | PHID= 0.                        |                                       |                                         |                                          |                   |                              |     | 6UI3A                                    | I                         |     |
| 133              | APHR = 1                        | ALP#RAD                               |                                         |                                          |                   |                              |     | SUI3A                                    | 1                         |     |
| 134              | RETURN                          |                                       |                                         |                                          |                   |                              |     | 6UI3A                                    | <u> </u>                  |     |
| 135              | 70 IFCALL                       |                                       | 80                                      |                                          |                   |                              |     | GUI3A                                    | 80-1                      |     |
| 136              | APHR = 1                        | REL+RAB                               |                                         |                                          |                   |                              |     | GUI3A                                    |                           |     |
| 137              | PHID= 9:<br>RETURN              | ٠.                                    |                                         |                                          |                   |                              |     | SUI3A<br>SUI3A                           | 1 1                       |     |
|                  |                                 |                                       |                                         |                                          |                   |                              |     |                                          | لــا                      |     |
| 139.             | 80 APHR =-                      |                                       |                                         |                                          |                   |                              |     | 6U13A                                    | l                         |     |
| 141.             | PHID=-9                         | ٠.                                    |                                         |                                          |                   |                              |     | GUI3A<br>GUI3A                           | ı                         |     |
| 142 C            |                                 |                                       |                                         |                                          |                   |                              |     | COWN                                     | I                         |     |
| 1143 0           |                                 | ITCH STEER                            | ING WITH                                | BANK =0                                  |                   |                              |     | COMN                                     | 1                         |     |
| 144              | 90 CONTINU                      |                                       |                                         |                                          |                   |                              |     | SUISA                                    | 1                         |     |
| 145              |                                 | LK(MNGALIPH                           | 73103 TIME                              |                                          |                   |                              |     | GUI3A                                    | 1                         |     |
|                  |                                 |                                       |                                         |                                          |                   |                              |     |                                          |                           |     |

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475

```
147.
148
149
150.
151.
152.
153.
154.
   PHID=0,
APHR=THP-GAMD
RETURN
EMTRY MNSET
MNGP(IPST,2) =MNGP(IPH,1)
MNGA(IPST,2) =MNGA(IPH,1)
RETURN
END
  GUI3A
GUI3A
GUI3A
GUI3A
GUI3A
GUI3A
GUI3A
```

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```
147
148
149
150
151
152
153
154
   PHID=0.
APHR=THP-GAMB
RETURN
ENTRY MNSET
MNGP(1P5T,2) =MNGP(1PH,1)
MNGA(1P5T,2) =MNGA(1PH,1)
RETURN
END
  GUI3A
GUI3A
GUI3A
GUI3A
GUI3A
GUI3A
GUI3A
```

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## FUNCTION ICOD

#### FUNCTION ICOD

#### Entry IVØD

#### Purpose

The main entry ICOD unpacks the initial condition option code from the packed data boundary condition array word.

The second entry IVOD unpacks the variable code from the word.

#### Description

As described in GEINP, the input boundary conditions are processed and stored on random file 9 record 21. Subroutine SDINP then reads file 9 and employs ICOD and IVOD to get information from the packed words. This information is used to set up internal codes and check input data.

```
1.
23.
4.
5.
6.
7.
8
9.
10
11.
12.
                                     FUNCTION ICODOREZS
                C
C
C
                                   UNPACKS OPTION CODE AND VARIABLE CODE FROM INITIAL CONDITION ARRAY

1 = REZ*1.E-6 +SIGN(.5,REZ)

Z= I*1.E6
F= REZ-Z
ICOD= F +SIGN( 5,REZ)
RETURN
ENTRY IVOD
ICOD = REZ*1.E-6 +SIGN(.5,REZ)
RETURN
ENTURN
END
```

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## SUBRØUT I NE I MPUL

#### Subroutine IMPUL

#### Purpose

IMPUL computes specific impulse for rocket propulsion options.

#### Description

This routine has two options, depending on whether JPRO equals 0 or 1. When JPRO = 0, it will compute a corrected ISP if the ISP loss table has been input. When JPR $\emptyset$  = 1, it will always compute a corrected ISP for the dual engine simulation (used with SSSP sizing only).

| FORTRAN | HIAM           | CODE | DESCRIPTION                                                                   |       | STORA     |      | SUBROUTIN                                                                                                              |                                                      |
|---------|----------------|------|-------------------------------------------------------------------------------|-------|-----------|------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| SYMBOL  | SYMBOL         |      | DESCRIPTION                                                                   |       | BLOCK     | LOC  | SUBR COO                                                                                                               | E VAR                                                |
| AE      | Aexit          | I    | Total nozzle exit area                                                        |       | /GENF /(  | 5201 | ACCEL I<br>FH2 I<br>IMPUL I<br>PROPB O<br>PROPIN O<br>SOER3 I                                                          | AE<br>AE<br>AE<br>AE<br>AE                           |
| FRATED  |                | I    | Net rated maximum rocket vacuum thrust                                        | (L85) | /GENF /   | 567) | IMPUL I<br>PROPB O<br>PROPIN O                                                                                         | FRATED<br>FRATED<br>FRATED                           |
| FVAC    |                | M    | Total vacuum thrust [rocket] .                                                | (LBS) | /GENF /(  | 528) | ACCEL I EQUAS M FH2 1 IMPUL M PROPB M PROPIN M 50ER3 I                                                                 | FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC |
| IFOB    |                | I    | Forward or adjoint integration flag<br>≈ 1 means forward<br>≈ 2 means adjoint |       | /XCODES/( | 178) | ACCEL I<br>BEROCO I<br>BLYNE I<br>EQUAS I<br>IMPUL I<br>SPLYNE I<br>TOPM O                                             | IFOB<br>IFOB<br>IFOB<br>IFOB<br>IFOB<br>IFOB         |
| IRATED  |                | I    | Maximum rated ISP                                                             | (SEC) | /GENF /(  | 568) | IMPUL I                                                                                                                | IRATED                                               |
| ISP     | Isp            | 0    | Net vacuum specific impulse                                                   |       | /GENF /   | 538) | ACCEL I<br>IMPUL O                                                                                                     | ISP<br>ISP                                           |
| ISPF    |                | 0    | Partial of ISP art vacuum thrust                                              |       | /GENF /(  | 539) | ACCEL I                                                                                                                | ISPF<br>ISPF                                         |
| JPRO    |                | I    | Propulsion model option flag                                                  |       | /ARCDAT/( | 10)  | EQUAS I<br>GEINP I<br>IMPUL I<br>MODELA I<br>PROPB I<br>PROPIN I                                                       | JPRO<br>JPRO<br>JPRO<br>JPRO<br>JPRO<br>JPRO         |
| MISP    |                | I    | Curve number kISP loss table                                                  |       | /ARCDAT/( | 26)  | IMPUL I<br>PROPB I<br>PROPIN I                                                                                         | MISP<br>MISP<br>MISP                                 |
| PA      | P <sub>a</sub> | I    | Atmospheric pressure                                                          | (PSF) | /GENF /(  | 308) | EQUA3 M<br>FH2 I<br>IMPUL I<br>OUT I<br>POBC I<br>SOER3 I                                                              | DZM<br>PA<br>PA<br>PA<br>PA<br>PA                    |
| τ       | T              | Î    | Thrust                                                                        | (LBS) | /GENF /(  | 411) | ACCEL I BLGCON M BL4 I BL6 I BL7 I BL8 I EQUA3 OFH1 I FH2 I FH3 I FH4 I IMPUL I PROPB O PROPIN O PROPIN O REUS SOERS I | T                                                    |
| X15P    | I sp           | I    | Vacuum specific impulse                                                       | (SEC) | /ARCDAT/( | 3 )  | IMPUL I<br>SIZIN O                                                                                                     | XISP<br>XISP                                         |

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```
I MMN AT COMM AT COMM ARCODAT ARCODAT ARCODAT ARCODAT ARCODAT ARCOB ARCO
           1.2345
   SUBROUTINE IMPUL
   C
   COMPUTES ISP FOR ROCKETS COMMON/ARCDAT/
  XISP
JAER
JAER
SMOOT
MAED
MXCG
ZCGR
RHOB
   COMMON/ARCDAT/
SREF | XI
*SREF | XI
*SREF | XI
*SREF | XI
*SREF | XI
*AT | IMDDE | JA
**XLRAX | HDMAX | SF
*AAEB | MARC | MARCO |
**MT | MISP | MX
**MDB | XCCR | ZC
**DREF | ARCDA |
**DIMENSION | ARCDA(40)
**EQUIVALENCE(SREF, ARCDA)
**COMMON/SENF/
   OTP1
GMAX
MAEA
MAEG
MUDB
   DTNC
DMAX
PHMAX
HAEF
MUDA
ZE
REMAX
  , THULT
  JPRO
ALFMAX
MAEE
MZCG
XE
6789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678
  ÖNULT
   GENEF, ARCDA)

GENEF,
OMGP(20,2), VARQ(9),
ACON(9),
OT G
RE , MACH
PAR ROR
TIMEPH , TIMES
TPH (20), DIS(20),
TLS1 (20), DIP1(20),
LIFT GRAG
TF FOOLD
QV FVAC
LIFTH , DBR
  COMMON/SENF/
*OMG(20) ,0
*A(9,9) ,A
*DTS ,D
   , MDC( 26 )
DTP
95
95
50MSQ
1E( 9 )
H
19MP
18U( 29 )
   *DTS*

*R
*VNU
*SVSQ
*TST(20)
*TLP1(20)
*TIMPR
*AE
*QR
   DRASA
ISPF
,ULFTA
,CODAE
,SIO
   ≠LIFTR
  DBR
ULFT
XMCGR
CALPHA
XCS
   *XMCS
*CULFT
   XMCGV
CT
SIDAE
GENF /
XJR
,IRATED
   *COD
COMMON /
*XJV
*FRATED
   *XJV XJR ,GH ,GAMMAD ,XKG ,XKP ,FRATED ,RATED ,P3 ,XK1 ,XK2 ,XK3 ,XK1 ,XK2 ,XK3 ,XK11 ,XK2 ,XK3 ,XK11 ,XK2 ,XK3 ,XK14 ,XK20 ,XK30 ,XK14 ,XK20 ,XK30 ,XK16 ,XK26 ,XK36 ,XK17 ,XK27 ,XK37 ,XK16 ,XK26 ,XK36 ,XK17 ,XK27 ,XK37 ,XK16 ,XK28 ,XK38 ,XK10 ,XK20 ,XK30 ,XK18 ,XK28 ,XK38 ,XK10 ,XK20 ,XK30 ,XK10 ,XX20 ,XK30 ,XX20 ,XX30 ,XX10 ,XX20 ,XX30 ,XX30 ,XX10 ,XX20 ,XX30 ,XX30 ,XX10 ,XX20 ,XX30 ,XX30 ,XX10 ,XX20 ,XX10 ,XX10 ,XX20 ,XX10 ,X
  , GH
  , GAMMAD
   , XKG
   GENF
   XCODES
   XCODES
XCODES
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XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
   IMPUL
IMPUL
COMM
   Ç
   TEST FOR DUAL ENGINE MODE

IF(JPRO.EQ.1) GO TO 20

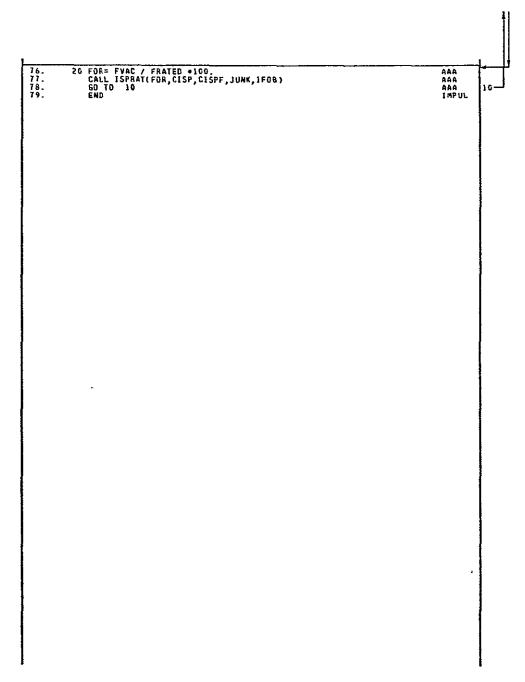
II IF ISP LOSS TABLE NOT INPUT RETURN

IF(MISP.LE.0) RETURN

FOR = FYAC/FRATED*100.

CALL SPLYNE(MISP,FOR,CISP,CISPF)
   1
  20-
   C
   IMPUL
   EMPUL
   10 ISP = CISP*IRATED*.01
IF(IFO8.E0.1) RETURN
ISPF= CISPF*.GI*IRATEO /FRATED
RETURN
69
70.
71
72
73.
74.
   AAA
   I APUL
   AAA
IMPUL
Comu
Comu
   CCC
   HI
   EFFECTIVE ISP FOR DUAL ENGINES WITH ONLY ONE THROTTLED OR VARYING WITH ARC-TIME
```

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20 DCT 72 G G1-96

# SUBROUTINE

#### Subroutine IPR

#### Purpose

IPR is a utility routine used for dumping on to the printer either fixed or tloating point arrays.

#### Printed Output

The output of IPR is a BCD name followed by either a 6 column E format array dump or 10 column fixed point array dump.

```
SUBROUTINE IPRO NAME, DATA, IDATA, N, IND)
   IPR
COMM
COMM
COMM
COMM
COMM
COMM
IPR
IPR
IPR
IPR
1.
3.
56.
7.
8.
10.
112.
13.
14.
15.
118.
  SUBGUTINE IPR( NAME, DATA, IDATA, N, IND)

UTILITY ARRAY DUMPER
IND =0 FLOATING PT DUMP
IND =1 FIXED PT DUMP
NAME = HOLLERITH LAGEL FOR DUMP
DATA = FLOATING PDINT ARRAY DR VARIABLE NAME
IDATA = FLOATING PDINT ARRAY DR VARIABLE NAME
DIMENSION DATA(1), IDATA(1)
PRINT 20, NAME
IPCIND.ED.0) GD TD 10
PRINT 3D,( IDATA(1), I=1, N)
RETURN

10 PRINT 40,(DATA(1), I=1, N)
RETURN
20 FORMAT (3X, A10)
30 FORMAT( 10 1 10 )
FORMAT( 6E17.8)
END
                        0000000
   10-
   IPR
IPR
IPR
IPR
IPR
```

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FUNCTION

#### FUNCTION LØMG

#### Purpose

LOMG returns an internally used (steepes + descent) stopping-variable print code given an input code.

#### Description

 $L\slash\hspace{-0.6em}Q\slash\hspace{-0.6em}M\slash\hspace{-0.6em}G$  is called from SDINP during the scan of boundary conditions.

LOMG

```
FUNCTION LOMG (K)
I=1A85(K)
IF(1.E0.1) GO TO 10
LOMG=I-1
RETURN
10 LOMG=I
20 RETURN
END
   LOMS
LOMS
LOMS
LOMS
LOMS
LOMS
LOMS
1
2
3.
5.
6
7.
8.
```

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## SUBRØUT I NE MAME CØ

#### Subroutine MAMECØ

#### Purpose

MAMECO computes the total aerodynamic moment coefficient and its derivative with respect to Mach number.

#### Description

MAMECØ is called from Subroutine VT.

| OHTRAN<br>SYMBOL | MATH<br>Symbol       | con | DESCRIPTION                        |       | \$10<br>8LU.K | ) R A I | iE<br>Loc | SUBKOU<br>SUBR                                                              |                       |                                                                      |
|------------------|----------------------|-----|------------------------------------|-------|---------------|---------|-----------|-----------------------------------------------------------------------------|-----------------------|----------------------------------------------------------------------|
| ALPHA            | α                    | I   | Angle of attack                    | (RAD) | /AECD3        | 70      | 3 }       | BEROCO<br>BLGCON<br>BLZ<br>FNTG<br>MAMECO<br>MODELA<br>MODELB<br>REU3<br>VT | M<br>I<br>O<br>I<br>M | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA |
| CM               | c <sup>M</sup>       | 0   | Moment coefficient                 |       | /AECD3        | 70      | 41)       | MAMECO<br>VT                                                                | 0                     | CM<br>CM                                                             |
| CMA              | C <sub>Ma</sub>      | i   | Moment coefficient slope           |       | /AEC03        | /(      | 42)       | EQUA3<br>MAMECO<br>VT                                                       | A<br>I<br>I           | CMA<br>CMA<br>CMA                                                    |
| CMAM             | ac <sub>M°</sub> ∖9w | 1   | See symbol                         |       | /AEC03        | /(      | 43)       | EQUA3<br>MAMECO                                                             | M<br>I                | CMAM<br>CMAM                                                         |
| Cmm              | 9C <b>%</b> /9M      | 0   | See symbol                         |       | /AECO3        | /(      | 44)       | MAMECO<br>VI                                                                | 0                     | CMM<br>CMM                                                           |
| CM0              | c <sup>wo</sup>      | I   | Moment coefficient at $\alpha = 0$ |       | /AEC03        | /(      | , 45)     | EQUA3<br>MAMECO                                                             | I<br>I                | CMO<br>CMO                                                           |
| CMOM             | ac <sub>Mo</sub> ∕am | I   | See symbol                         |       | /AEC03        | /(      | 46)       | EQUA3<br>MAMECO                                                             | I<br>I                | CMOM<br>LMOM                                                         |

```
CD

REPT SERVICE SERVI
, WDC(20)
OTP
OS
CS
, SUMSO
, TR(9)
, M
OMP
, TBU(20)
, MACHY
   DRAGA
ISPF
ULFTA
CODAE
SID
  , SAMMAD
   , XKG
  , XKP
   (2 , XK3
(2D , XK3D
(2D , XK3D
(2V , XK3V
(2P , XK3P
(2D , XK3P
(2M , XK3M
) DPDY(3,8)
   , XK2
, XK20
, XK2V
, XK2P
, XK20
, XK2M
, PO
   GENF
GENF
GENF
GENF
GENF
GENF
GENF
GENF
   ALPHA YDA
PHIO PHID
POPH XLAMA(9)
FK XCGM
CMAR CMM CMO
CLA CLM
CDM
  PDA
SINPHI
CDB
CLOM
FKM
   ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
   MAMECO
```

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## SUBRØUT I NE MØDELA

#### Subroutine MODELA

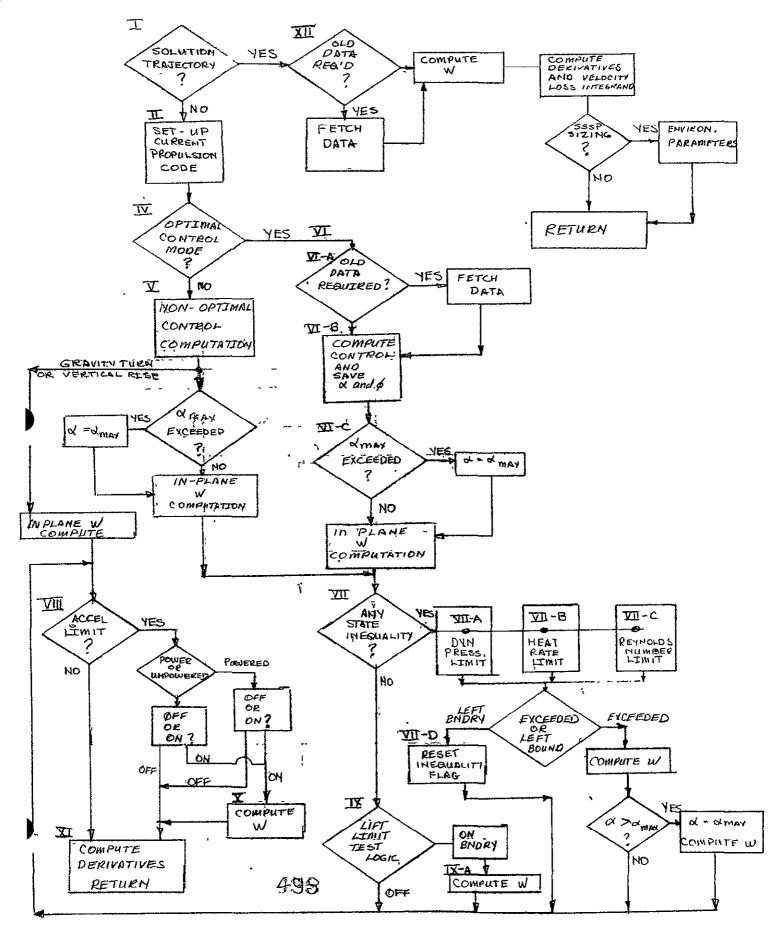
#### Purpose

MODELA governs the computation of the control vector and sets up the derivative calculation during the forward trajectory integration.

#### Description

The way the control vector is calculated depends on options in the program and also on control and state inequality constraints. MODELA does not calculate the control vector (BLGCØN does), but it does test the result of either optimizing or non-optimal control computations to determine if instantaneous constraints have been violated. If constraints are violated, the control mode is instantaneously changed and control is recalculated on the appropriate constraint boundary. After the bounded control is computed, the derivatives are calculated and returned to the calling routine, FNTG.

#### SUBROUTINE MODELA



| FORTRAN<br>Symbol | MATH<br>Symbol   | CODE        | DESCRIPTION                        |        | STORAG<br>BLOCK | E<br>LOC | SUBROUTII<br>SUBR COL                                                                                     | NE USAGE<br>De var                                                                               |
|-------------------|------------------|-------------|------------------------------------|--------|-----------------|----------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
|                   |                  | <del></del> |                                    |        |                 |          | ·                                                                                                         |                                                                                                  |
| ALFMAX            | <sup>α</sup> MAX | 1 Maxim     | um angle of attack                 | (\$56) | /ARCBAT/(       | 16)      | INBVAD M<br>MODELA I<br>MODELB I                                                                          | ALFMAX<br>ALFMAX<br>ALFMAX                                                                       |
| ALFSAV            |                  | W Angle     | of attack prior to control boundry |        | /MODELA/(+      | )        | MODELA W                                                                                                  | ALFŞAV                                                                                           |
| ALPHA             | α                | Fl Angle    | of attack                          | (RAD)  | /AEC03 /(       | 31       | BEROCO I<br>BLGCON M<br>BL2 I<br>FNTG O<br>MAMECO I<br>MODELA M<br>MODELA M<br>MODELA O<br>REU3 O<br>VT I | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA                    |
| APHR              | α                | fi Angle    | of attack                          | (DEG)  | /AEC03 /(       | 2)       | AGETB3 0<br>AST3 M<br>BEROCO I<br>BLGCOM 0<br>GUI3A M<br>MODELA M<br>MODELB I<br>MTX3A 0<br>OUT I         | APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR                                     |
| CALPHA            |                  | M Const     | ant value of angle-of-attack       | (RAD)  | /GENF /(        | 552)     | BL2 I<br>MODELA M<br>MODELB M                                                                             | CALPHA<br>CALPHA<br>CALPHA                                                                       |
| COSGAM            | cos(7)           | I See s     | p=bol                              |        | /STATE3/(       | 687)     | ACCEL I BL4 I BL8 I DER3A I DEQUAS O MODELA I MODELB I OUT I PDBC I PDBYSA I                              | COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM<br>COSSAM |
| COSPHI            | cos∲             | M See sy    | mbo 1                              |        | /AEC03 /(       | 13)      | ACCEL I<br>BL4 I<br>GUI3A M<br>MODELA M<br>MODELB M<br>OUT I                                              | COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI                                         |
| COSPS1            | c a s ( 少 )      | I See sy    | •ebo I                             |        | /STATE3/(       | 705)     | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>PDBC I<br>PDBC I                 | COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI           |
| COSAHO            | cοs(ρ)           | I See sy    | abo i                              |        | /STATE3/(       |          | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EDUA3 M<br>MODELA I<br>MODELA I<br>MODELB I<br>PDBC I<br>PDBC I     | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO |
| COSZGA            | cos(27)          | 0 See sy    | ∍bo l                              |        | /STATE3/C       | 757)     | MODELA 0                                                                                                  | C0526M                                                                                           |
| COS2RO            | cos(2p)          | O Seesy     | abe i                              |        | /STATE3/C       |          | MODELB O BL4 1 BL7 m BL8 m MODELA O MODELB O                                                              | COS2GN<br>COS2RO<br>COS2RO<br>COS2RO<br>COS2RO<br>COS2RO                                         |

8 NDV 72 G 01-46

| FORTRAN<br>Symbol | MATH<br>Symbol   | COD | <pre>DESCRIPTION</pre>                                                              |             | BLOCI   | 0840     | LOC  | SUBROUTING<br>SUBR COOK                                                                                                                               | E USAGE                                                                                          |
|-------------------|------------------|-----|-------------------------------------------------------------------------------------|-------------|---------|----------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 3111800           | STHEEL           |     | 22001127 12011                                                                      | <del></del> | 8600    | <u> </u> | 100  | 300H C001                                                                                                                                             | _ WN                                                                                             |
| CULFT             |                  | 0   | Constant value of ULFT                                                              | (LBS)       | /GENF   | K        | 550) | 8L3 i<br>modela b                                                                                                                                     | CULFT<br>CULFT                                                                                   |
| G                 | 9                | Î   | Gravitational attraction                                                            | (FT/SEC++2) | /GENF   | 70       | 301) | BLT I<br>BLT I<br>GER3A I<br>EQUAS M<br>MODELA I<br>MODELA I<br>MODELA I<br>SOERS I<br>SOERS I                                                        | ***************************************                                                          |
| GRAX              | G <sub>MAX</sub> | I   | Maximum total acceleration g load                                                   |             | /ARCDA  | T/(      | 12)  | BL5 I<br>FH3 I<br>MODELA I<br>PROPB I<br>PROPIN I                                                                                                     | GMAX<br>GMAX<br>GMAX<br>GMAX<br>KAMB                                                             |
| 6MDOT             | ?*               | 1   | Pitch rate                                                                          | (DEG/SEC)   | /ARCDA  | 1/(      | 15)  | DER3A I<br>MODELA I<br>MODELB I<br>PROPB I<br>PROPIN I                                                                                                | GMDOT<br>GMDOT<br>GMDOT<br>GMDOT<br>GMDOT                                                        |
| IARC              |                  | 1   | Arc number                                                                          |             | /xcobe  | \$/(     | 1463 | ADICB3 I<br>ADICSA I<br>ADJUST I<br>AST3 I<br>BNTS M<br>ENVPRM I<br>FNTG M<br>GETIT I<br>MODELA I<br>PROPEN I<br>REU3 I<br>REU3 I<br>STAU I<br>STAU I | IARCCIARCCIARCCIARCCIARCCIARCCIARCCIARC                                                          |
| 1START            |                  | G   | Initialization and divergance flag                                                  |             | /xcode: | \$/(     | 147) | AST3 D BL8CON D BLYNE D FNTS 1 MODELA D PROPIN D REU3 1 TEST M TOPM M                                                                                 | ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART |
| :TER              |                  | I   | Trujectory pass indicator.  ITER = i, CONSTRAINTS  = 2, OPTIMIZATION  = 3, SOLUTION |             | /xcobe: | \$/(     | 149) | AST3 I<br>FNTS I<br>SETIT I<br>MODELA I<br>OUT I<br>PAYO2 M<br>PROPIN I<br>TEST M<br>TOPM M                                                           | ITER ITER ITER ITER ITER ITER ITER ITER                                                          |
|                   |                  | I   | Control uption                                                                      |             | /xcone: | 5/(      | 195) | BNTS 0<br>DER3A 1<br>FNTS M<br>GUI3A 1<br>MODELA 1<br>MODELB 1<br>MTX3A 1                                                                             | J611<br>J611<br>J611<br>J611<br>J611<br>J611<br>J611<br>J611                                     |

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| FORTRAN       | MATH     | COD       | E DESCRIPTION                                                                   | STORAC    |      | SUBROUTINE USAGE                                                                               |
|---------------|----------|-----------|---------------------------------------------------------------------------------|-----------|------|------------------------------------------------------------------------------------------------|
| SYMBOL        | SYMBOL   |           | - DESCRIPTION                                                                   | BLOCK     | LOC  | SUBR CODE VAR                                                                                  |
| JK            |          | 1         | Integration routine flag tells which derivative evaluation in Runge-Kutta cycla | /xcobes/c | 151) | ADICJA M JK<br>BNTG I JK<br>MODELA I JK<br>PAYOZ M JK<br>RKTAJA M J<br>RKTBJA M J              |
| JPR0          |          | I         | Propulsion model option flag                                                    | /ABCDAT/( | 10)  | EQUAS I JPRO<br>GEINP I JPRO<br>IMPUL I JPRO<br>MODELA I JPRO<br>PROPB I JPRO<br>PROPIN I JPRO |
| JPRP          |          | I         | Propulsion flag for different rocket options                                    | /XCODES/( | 194) | ACCEL I JPRP DER3A I JPRP EQUA3 I JPRP MODELA I JPRP PDY3A I JPRP PROPB O JPRP PROPIN O JPRP   |
| JP1           |          | <b>19</b> | Option flag for first governing equation                                        | /xcodes/( | 217) | AGETB3 M JP1 AST3 M JP1 MODELA M JP1 MODELB I JP1 PROPEN O JP1 PROPIN O JP1                    |
| JP2           |          | 1-        | Option flag for second governing equation                                       | /XCODES/( | 218) | MODELA I JP2<br>MODELB I JP2<br>PROPB O JP2<br>PROPIN O JP2                                    |
| JP3           |          | A         | Option flag for third governing equation                                        | /XCODES/( | 2193 | AGETB3 0 JP3<br>AST3 M JP3<br>MODELA M JP3<br>MODELB I JP3<br>OUT I JP3<br>PROPIN 0 JP3        |
| 9 <b>Y</b> 7L |          | 1         | Sīzíng. Flag.                                                                   | /SIZING/( | 313) | FNTG I JTYP GEINP 0 JTYP MODELA I JTYP PAOSI I JTYP PROPIN I JTYP SIZIN I JTYP TRTOSZ I JTYP   |
| K             |          | I         | Storage retrieval flag indicates end of arc, phase, or data.                    | /xcodes/c | 156) | AST3 0 K FNTG 0 K GETIT M K MODELA I K SDINP M K                                               |
| O CORHO       | ω×CO5RHO | I         | See symbol                                                                      | /STATE3/C | 708) | DERSA I OCORHO EQUAS M DCORHO MODELA I OCORHO PDBC I OCORHO PDYSA I OCORHO                     |
| OCORO2        | ω×0C0RH0 | I         | See symbol                                                                      | /STATE3/( |      | DER3A I OCORO2<br>EQUA3 O OCORO2<br>MODELA I OCORO2<br>MODELB I OCORO2<br>PDY3A I OCORO2       |

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| FORTRAN | MATH   | CODE DESCI                 | RIPTION                   | STORAG     |      | SUBROUTINE USA                                                                                                                                                                                   |
|---------|--------|----------------------------|---------------------------|------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL | DE 201                     | AIFIIUN                   | BEOCK      | FOC  | SUBR CODE VA                                                                                                                                                                                     |
| OMGZ    | ω      | I Earth rotation rate      | (RAD/SEC)                 | /GLOBAL/(  | 31   | ADID3A I OM6Z<br>CRASH I OM6G<br>DER3A I OM6Z<br>EQUA3 I OM6Z<br>GEINP I OM6Z<br>MODELA I OM6Z<br>MODELA I OM6Z<br>POY3A I OM6Z<br>POY3A I OM6Z<br>SDINP I OM6Z<br>TOPM I OM6Z                   |
| PHI     | ø      | M Bank angle               | (RAD)                     | /AEC03 /(  | 11)  | GUISA M PHIR<br>MODELA M PHI<br>MODELB M PHI<br>OUT I PHI                                                                                                                                        |
| PHIC    | ø      | M Bank angle               | (DEG)                     | /AEC03 /(  | 10)  | AGETB3 0 PHID<br>AST3 M PHID<br>GUI3A M PHID<br>MODELA M PHID<br>MODELB I PHID<br>MIX3A 0 PHID<br>OUT I PHID                                                                                     |
| PHISAV  |        | W Bank angle prior to cont | roi boundry               | /MODELA/(+ | )    | MODELA W PHIS                                                                                                                                                                                    |
| Ř       | R      | I Radial distance from ear | th center to vehicle (FT) | /GENF /(   | 305) | BL4 I R<br>BL7 I R<br>BL6 I R<br>DER3A I R<br>EQUA3 M R<br>MODELA I R<br>MODELB I R<br>PDBC I R<br>PDBC I R<br>FDBC I R<br>FDBC I R                                                              |
| RAÜ     |        | I Radian to angle conversi | on, 57 29577951           | /DATA /{   | 2)   | BEROCO I DEG<br>BLGCON I RAD<br>ENVPRM I RAD<br>EQUAS I RAD<br>GUISA I RAD<br>MODELA I RAD<br>MODELA I RAD<br>OUT I RAD<br>OUT I RAD<br>PADSSI D RAD<br>STREET                                   |
| RDI     |        | I Angle to radian conversi | on, 01745329252           | /DATA /(   | 3)   | BLICO I RDI<br>DERSA I ROI<br>FNIG I RDI<br>GUISA I RDI<br>MODELA I RDI<br>MODELA I RDI<br>PADSI D RDI<br>PROPIN I RDI<br>PROPIN I RDI<br>REUS I ROI<br>SDINP I RDI<br>SDINP I RDI<br>SOMS I RDI |
| SINGAM  | sin()  | I See sy≋bol               |                           | /STATE3/(  | 688) |                                                                                                                                                                                                  |

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| FORTRAN<br>Symbol | MATH<br>Symbol                        | COD | E            | DESCRIPTION                                        | STORAG<br>Block | E<br>LOC | SUBROUTINE USA<br>SUBR CODE VA                                                                                                                                                                             |
|-------------------|---------------------------------------|-----|--------------|----------------------------------------------------|-----------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | · · · · · · · · · · · · · · · · · · · |     |              |                                                    |                 |          |                                                                                                                                                                                                            |
| SINPHI            | sin≠                                  | M   | See          | symbo i                                            | /AEC03 /(       | 12)      | ACCEL I SINP<br>BL9 I SINP<br>MODELA M SINP<br>MODELB M SINP<br>OUT I SINP                                                                                                                                 |
| SINPSI            | sīn(∳)                                | ĭ   | See          | symbol                                             | /STATE3/(       | 704)     | BL4 I SIMP<br>BL7 I SIMP<br>BL8 I SIMP<br>DER3A I SIMP<br>EQUA3 0 SIMP<br>MODELA I SIMP<br>MODELB I SIMP<br>PD8C I SIMP<br>PD93A I SIMP                                                                    |
| SINRHO            | sin(ρ)                                | ı   | See          | syabol                                             | /STATE3/(       | 706)     | BL4                                                                                                                                                                                                        |
| SIN2RO            | sin(2ρ)                               | Đ   | See          | symbol                                             | /STATE3/(       | 755)     | BL4 I SIN2<br>BL7 A SIN2<br>BL8 M SIN2<br>MODELA D SIN2<br>MODELB D SIN2                                                                                                                                   |
| SQRT              |                                       | F   | Squi         | ore root function                                  | /SQRT /(\$      | ,        | ANLATM F CRASH F CRASH F CRASH F SQRT DETT DETT DETT DETT DETT DOT DETT DOT DOT DOT DOT DOT DOT DOT DOT DOT D                                                                                              |
| TBUAN             | t <sub>b</sub>                        | 3   | Rock<br>traj | ket burn initistion time on formard<br>jectory[sd] | /GENF /(        | 499)     | EQUAS I TBUR<br>MAGELA I TBUR<br>PROPB O TBUR<br>PROPIN M TBUR                                                                                                                                             |
| TIME              | t                                     | Ī   | Time         | e (elapsed)                                        | /GENF /(        | 493)     | ADICB3 O TIME AST3 I TIME BATS I TIME BATS I TIME CONS I TIME ENVPRM I TIME EQUAS I TIME EQUAS I TIME EQUAS I TIME EQUAS I TIME PADELA I TIME OUT I TIME PAGPIN I TIME REUS M TIME REUS M TIME RETASA M TT |
| TPRP              |                                       | н   | Bura         | n time                                             | /modela/(*      | ,        | YREF3 M TIME<br>MODELA W TPRP                                                                                                                                                                              |

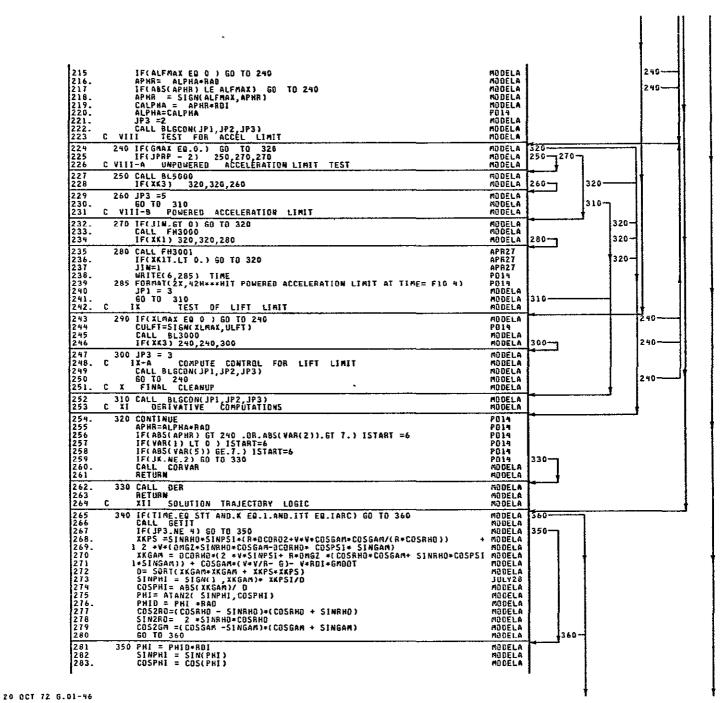
| FORTRAN<br>Symbol | MATH<br>Symbol   | coo | DESCRIPTION                                   | V        | S TORA<br>Block | GE<br>LOC | SUBROUTINE<br>SUBA CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | US AGE<br>VAR                                                          |
|-------------------|------------------|-----|-----------------------------------------------|----------|-----------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| ULFT              | L <sub>U</sub>   | 1   | Untrimmed sero.lift                           |          | /GENF /(        | 540)      | MODELA I U                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | SLFT<br>SLFT                                                           |
| ٧                 | •                | 1   | Relative velocity                             | (FT/SEC) | /STATE3/(       | 1)        | ACCEL I WASTESS ON ACCESS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | AR<br>FAR<br>FAR<br>FAR<br>FAR<br>FAR<br>FAR<br>FAR<br>FAR<br>FAR<br>F |
| VAR               | •                | Ĭ   | Relative velocity                             | (FT/SEC) | /STATE3/(       | 1)        | ACCEL I V<br>ADICB3 O V<br>ADJUST W V<br>AST3 I V<br>BL3 I V<br>BL4 I V<br>BL7 I V<br>BL8 I V<br>BL8 I V<br>DER3A I V<br>ENVPRM I V<br>ENVRM I V<br>E | ARRAR AR A                               |
| XKGAM             | K,               | Я   | Algebraic equation used in vertical pitchover | rise and | /GENF /(        | 565)      | BL4 I X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | KG<br>KGAM<br>KGAM                                                     |
| XKPS              | k <sub>y</sub> , | M   | Algebraic equation used in vertical pitchover | rise and | /GENF /(        | 566)      | MODELA M X MODELA I X MODELB M X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | KP<br>KPS<br>KPSI<br>KPS<br>KPSI                                       |
| XKPSI             | k <sub>¢</sub>   | 1   | Algebraic equation used in vertical pitchover | rise and | /GENF /(        | 566)      | BL4 I X<br>MODELA M X<br>MODELA I X<br>MODELB M X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | KPS<br>KPSI<br>KPSI<br>KPS                                             |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE DESCRIPTION                                                                                      |             | BLOCK     | GE<br>LOC | SUBR COD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------|----------------|-------------------------------------------------------------------------------------------------------|-------------|-----------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| STHOUL            | 21 mant        | DESCRIPTION                                                                                           |             | BLULK     | LUC       | 3084 600                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | E VAN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| XK1               |                | 1 First control vector governing equation corresponds to error in thrust                              | value       | /GENF /(  | 5721      | BLGCOM I<br>FHI O<br>FH2 O<br>FH3 O<br>FH4 O<br>MODELA I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | XK1<br>XK1<br>XK1<br>XK1<br>XK3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| KKIT              |                | 1 Partial of governing equation and state vector component                                            | or control  | /GENF /(  | 575)      | BLGCON I<br>FH1 D<br>FH2 O<br>FH3 M<br>FH4 O<br>MODELA I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | XK1T<br>XK1T<br>XK1T<br>XK1T<br>XK1T                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| KK3               |                | 3 Third control vector governing equation<br>Corresponds to error in algebraic equati<br>involving «. | value<br>on | /GENF /(  | 574)      | BL2 0<br>BL3 0<br>BL4 0<br>BL5 0<br>BL7 0<br>BL7 0<br>MODELA I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ##3<br>##3<br>##3<br>##3<br>##3<br>##3<br>##3<br>##3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| (LMAX             | LMAX           | I Maximum merodynamic lift                                                                            | (LBS)       | /ARCDAT/( | 13)       | MODELA I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | XLMAX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| UNG6 -            |                | O File of all output data                                                                             |             | /.UN06 /( | \$ )      | BLICO D BRASHCH D BRASHCH D BRASHCH D BRASHCH D GEINP D GEINT D GEINP D GEINT D GEINP D GEINT D GEINP D GEINT D GEINP | . UNO6 |

|   | THIS ROUTINE C                                                                                                                                               | ONTROLS COMP                                           | UTATION OF C    |                                         | ECTOR                  | MOD<br>Sta |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------|-----------------------------------------|------------------------|------------|
|   | *VAR(14) .DVAR (                                                                                                                                             | 14), VARL (99                                          | DVARL(99)       | ,YO(9)                                  | ,SVY(10)<br>,SAVBP(15) | STA        |
|   | *XL(7.9) .YUF(20.                                                                                                                                            | 9),YOS (20,9                                           | ), COSGAM       | .SINGAM                                 | ,SAVBP(15)             | STA        |
| - | *SINPŠI ,COSPSI'<br>*SVBV (9).OMEGA                                                                                                                          | SINAHO<br>DMEGA2                                       | COSRHO          | ,ocorno                                 | ,0CORB2                | STA        |
|   | *VDV GDV                                                                                                                                                     | ROV                                                    | , MDV           | ,PDV                                    | ,004                   | . STA      |
|   | *UDV , VOG<br>*UDS , VOR                                                                                                                                     | ans                                                    | RDG             |                                         | 111314                 | STA        |
|   | ¥UDG (VDR                                                                                                                                                    | HIN                                                    | . ADR           | PHX                                     | IIIIK                  | STA        |
|   | +UUK ,¥UM                                                                                                                                                    | . 50A                                                  | _ MB/Q          | PUM                                     | VIIP                   | , STA      |
| • | #KUP PAP                                                                                                                                                     | .00P                                                   | . 11012         | , VD0                                   | , śób .                | STA        |
|   | *PDO ,UDO<br>REAL MOM ,MOV, MO                                                                                                                               | HTDV                                                   | HTDR            |                                         | •                      | STA<br>STA |
|   | COMMON/STATES/                                                                                                                                               |                                                        |                 |                                         |                        | STA        |
|   | ¥51N2R0 C052R0                                                                                                                                               | , COS26M                                               |                 |                                         |                        | STA        |
| • | COMMON /XCODES/                                                                                                                                              |                                                        |                 |                                         | •                      | · xco      |
|   | *ITO (9),1COR (                                                                                                                                              | 20),171                                                | , INTB          | , JGIQ( 20,                             | 2), JPH (20,2          | ), XCO     |
|   | *JST (20)<br>*I20P ,ICOP                                                                                                                                     | NCNST<br>IFAN                                          | ,NSB<br>,IFAR   | ,NSAB<br>,1FB                           | , NI CNB<br>, I ND     | , XCO      |
|   | *IOPEN , IPH                                                                                                                                                 | ISPH                                                   | , isst          |                                         |                        | žčo        |
|   | #1161 .11EK                                                                                                                                                  | IVAH                                                   | 1 K             | , JPS<br>, NAD                          | ,15,44,                | xco        |
|   | ***** . ****                                                                                                                                                 |                                                        | . KS I          | NAB                                     |                        | , xco      |
|   | ≠NCN ,NEQB                                                                                                                                                   | . NEU                                                  | . NOP           |                                         | M                      | XCO        |
|   | ≠NST ,IPST                                                                                                                                                   | IPRINT                                                 | ISTN            | ,IPHN                                   | TZIMB                  | . XC0      |
|   | *1EUB NO                                                                                                                                                     | , IBLK2                                                | ISTOP           | ,15177                                  | L                      | xco        |
| • | *IPHNB , IBLKI *IFOB , NB *NCTIN , NEQF , I EQUIVALENCE (VARCI *(VARCI), PSI), (VARC *(DVAR(1), VD), (DVAR *(DVAR(6), OD), (DVAR REAL M, MU, MD COMMON/GENF/ | LAB(8).JPRP.                                           | JGÍT MTT MPT    | N(20) JP1.                              | JP2.JP3                | XCO        |
|   | EQUIVALENCÉ (VAR(1                                                                                                                                           | ).V) (VAR(2                                            | ) GAR) (VAF     | (3).ALT) .                              | (VAR(4), M) .          | EQU        |
|   | +(YAR(5), PSI), (VAR(                                                                                                                                        | 6),RHĎ),(VAR                                           | (1),8U),(VAF    | (C8),HT) , ´                            | ( VAR( 9 ), 502)       | , EQU      |
| • | *(DVAR(1),VD),(DVAR                                                                                                                                          | (2),60),(DV4                                           | R(3), HD), (D)  | (AR(4), MD),                            | (OVAR(5),PD)           | , EQU      |
|   | PEAL W WIT MU                                                                                                                                                | (,,,na),(na                                            | H(B), HID), (1  | JVAK( 4 ), 5W2                          | (8)                    | ÉQU<br>EQU |
|   | COMMON/GENF/                                                                                                                                                 |                                                        |                 |                                         |                        | GEN        |
|   | <b>+0MG(20) .0MGP(20</b>                                                                                                                                     | 21 VARD(9)                                             | ,TOL(9)         | .SVAR(10)                               | MBC(20)                | , GEN      |
|   | *A(Y.Y) .ACUN(Y)                                                                                                                                             | HURNI 9 )                                              | .CDTI(9.9)      | 1 1111111111111111111111111111111111111 | ,uir                   | , GEN      |
| • | ≠DTS .DT                                                                                                                                                     | 16                                                     | . NPSO          | 0                                       |                        | , GEN      |
|   |                                                                                                                                                              |                                                        | , PA            | . KU                                    | , cs                   | , GEN      |
| • | *CACU TIMEDO                                                                                                                                                 | ,ROR<br>,TIMES                                         | CSR<br>TOP      | , VNR<br>, TOS                          | , SUMSO<br>, TR(9)     | GEN        |
|   |                                                                                                                                                              | 20),015(20)                                            | BIPCZUI         | ΄τ                                      |                        | GEN        |
|   | #1(P1(20) 1151 (                                                                                                                                             | 261 DIPICZAI                                           | .0151(20)       |                                         |                        | SEN        |
|   |                                                                                                                                                              | BRAG                                                   | .TAX            | LIBURN                                  | - 100(50)              | , GEN      |
| • | FAL FP                                                                                                                                                       | FPRER                                                  | . FPO           | , MACHR                                 | , MACHY                | GEN        |
| • | *OR OV<br>*LIFTR , LIFTA                                                                                                                                     | FVAC                                                   | ,L1FTV<br>DRAGV | DRAGA                                   | DRAGA<br>,15PF         | GEN<br>GEN |
|   | LIFTH                                                                                                                                                        | DBR                                                    | ,DB             | , ISP                                   | 158F                   | GEN        |
|   | #                                                                                                                                                            | ULFT                                                   | JULFTV          | LULFIR                                  |                        | GEN        |
|   | *XMCGV ,XMCGV                                                                                                                                                | , XMCGR                                                | , XMCGA         | . XMCGM                                 | CODAL                  | , GEN      |
| - | ≠COLFI ,CI                                                                                                                                                   | CALPHA                                                 | , CDE           | .DELTAE                                 | ,510                   | GEN        |
| • | +COD ,SIDAE<br>COMMON / GENF /                                                                                                                               | XCG                                                    | ZCG             | , xJ                                    |                        | GEN<br>GEN |
|   |                                                                                                                                                              | , GH                                                   | , GAMMAD        | , XKG                                   | , XKP                  | GEN        |
|   | *FRATED TRATED                                                                                                                                               |                                                        | •               |                                         | · ·                    | GEN        |
| • | #P1 97                                                                                                                                                       | , P3                                                   | ,XK1            | , XX2                                   | , XK3                  | , GEN      |
|   | #15() 1621                                                                                                                                                   |                                                        | . XXID          |                                         |                        | GEN        |
|   | # I K   G   T   E   C   C   C   C   C   C   C   C   C                                                                                                        | . 1K34                                                 | XKIV            |                                         |                        | , GEN      |
|   | *XK16 ,XK26<br>*XK1R ,XK2R                                                                                                                                   | XK36<br>XK3R                                           | ,XK1P<br>,XK10  | , XK2P<br>, XK20                        | , XX3P<br>, XX30       | , GEN      |
|   | *XKIU ,XK2U                                                                                                                                                  | XK3U                                                   | , XK10          | 1829                                    | , XK3M                 | SEN        |
|   | ≠PV PG                                                                                                                                                       | PP                                                     | , PR "          | . PH                                    | .OPDY(3.8)             | GEN        |
|   | REAL LISTE LIST                                                                                                                                              | , XR3U<br>PP<br>LIFTA, LIF<br>LIFTV , IRAT<br>TST1(10) | T6',            | "MACH,                                  | MÁCHR,                 | ŠEN        |
|   | * ISP, ISPF, MACHY,<br>DIMENSION TPHICIO)                                                                                                                    | LIFTV , IRAT                                           | ED              | •                                       | •                      | FRA        |
|   | DIMENSION TPHI(10)                                                                                                                                           | ,1511(10)                                              |                 |                                         |                        | SEN        |
|   | EQUIVALENCE(TLP1,T                                                                                                                                           | rnı <i>ı,</i> (1651,1                                  | 211)            |                                         |                        | GEN<br>Arc |
| • | #CREE EI                                                                                                                                                     | , XISP                                                 | ,TMULT          | DINE                                    | ,OTPI                  | . ARC      |
|   |                                                                                                                                                              | .JAFR                                                  | (PRD            |                                         |                        | ARC        |
|   |                                                                                                                                                              | . 20001                                                | . ALFBAX        |                                         |                        | ARC        |
|   | # M G F N M G G F I T                                                                                                                                        | MAFD                                                   | .MAEE           | mbee.                                   | AGEL                   | , ARC      |
|   | ¥#II .NI5P                                                                                                                                                   | . PLX C.G.                                             | . MZ.C.G        | muna                                    | MININ                  | , ARC      |
| • | *MDB XCGR<br>*DREF MCND                                                                                                                                      | ZCGR<br>RHOB                                           | .XE             | . ZE                                    | ,xT                    | , ARC      |
|   | * FRATE ARCD(9)                                                                                                                                              | KNUB                                                   | , OMULT         | REMAX                                   |                        | RET        |

| 47.<br>48<br>49                         | PHID=PHI*RAD<br>GO TO 240<br>C V-B VERTICAL RISE OR PITCHOVER                                                                                                                                                                                                                                                                                                                                                       | PO14<br>MODELA<br>MODELA                                                     |         | 246-         |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|---------|--------------|
| 012345678901                            | 1 2 *V*(@mgZ*SINRHD*C@SGAM-DC@RHD* CDSPSI* SINGAM)  XKGAM = DCDRHD*(2.*V*SINPSI* R*DMGZ *CGSRHD*CDSGAM* SINRHD*CDSPS'  1*SINGAM)) + CDSGAM*(V*V/R- G)- V*RDI*GMDDT  D= SGRT(XKGAM*XKGAM + XKPS*XKPS)  SINPHI = SIGN(1, XKGAM)* XKPSI/D  COSPHI= ABS(XKGAM)/ D  PHI= AIANZ(SINPHI, COSPHI)  SINRHO = 2 *SINRHO* COSRHO-SINRHO;  CDSZGM=(COSRHO +SINRHO)*(COSGAM + SINGAM)  CDSZGM=(CDSGAM -SINGAM)*(COSGAM + SINGAM) | MODELA<br>MODELA<br>JULY28<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA |         |              |
| 2<br>3<br>4<br>5<br>6<br>7<br>8         | GO TO 90  C V-C TEST FOR ALFMAX ON A NON-OPTIMAL CONTROL MODE  110 JP3= 2  IF(ALFMAX.EQ D) GO TO 120  IF(ABSIAPHA) GT ALFMAX)APHR = SIGN(ALFMAX,APHR)  CALPHA = APHR*RDI  ALPHA=CALPHA                                                                                                                                                                                                                              | MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>PO14             | 120-    | <del>]</del> |
| 69<br>70<br>71<br>72<br>73              | 120 CALL BLGCON(JP1,JP2,JP3) G0 T0 170 C VI ON AN DPTIMAL CONTROL MODE C VI-A TEST WHETHER OLD DATA IS REQUIRED 130 IF(TIME_EQ.STI AND.K EQ 1 AND.ITT.EQ.IARC) GD TO 140                                                                                                                                                                                                                                            |                                                                              | 176     | ]            |
| 74<br>75.<br>76<br>77<br>78<br>79<br>80 | CALL GETIT C VI-B COMPUTE CONTROL CALL MTXI ALFSAV=APHR PHISAV=PHID GO TO 142 C VIC TEST FOR ALFMAX                                                                                                                                                                                                                                                                                                                 | MODELA<br>MODELA<br>MODELA<br>APR27<br>APR27<br>APR27<br>MODELA              | 142-7   |              |
| 81<br>82<br>83<br>84                    | 140 APHR=ALFSAY<br>PHIO=PHISAY<br>142 IF(ALFMAX EQ.O.) GO TO 150<br>IF(ABS(APHR) GT ALFMAX) APHR = SIGN(ALFMAX,APHR)                                                                                                                                                                                                                                                                                                | APR27<br>APR27<br>APR27<br>MODELA                                            | 150-    |              |
| 35.<br>36.<br>37.<br>38.<br>39.<br>90.  | 150 CALPHA= APHR+RDI ALPHA=CALPHA PHI=PHID+RDI SINPHI= SIM(PHI) COSPHI= COS(PHI) JP3 =2 160 CALL BLGCON(JP),JP2,JP3) C VI TEST FOR STATE INEQUALITIES                                                                                                                                                                                                                                                               | MODELA<br>PO14<br>MODELA<br>MODELA<br>MODELA<br>MODELA<br>MODELA             |         | ,            |
| 93<br>94<br>95<br>96                    | 170 IF(INQF EQ 0) 50 TO 290<br>IF(INOF-8) 180,190,200<br>C VII-A TEST FOR BNORY ON DVN PRES.<br>180 CALL BL7000<br>SO TO 210                                                                                                                                                                                                                                                                                        | MBDELA<br>MBDELA<br>MBDELA<br>MBDELA<br>MBDELA                               | 216-7   |              |
| 98<br>99<br>00<br>01                    | C VII-B TEST FOR BNDRY ON HEAT RATE  190 CALL BL8000 GD TO 210 C VII-C TEST FOR BNDRY ON REY NO  200 CALL BL9000                                                                                                                                                                                                                                                                                                    | MODELA<br>MODELA<br>MODELA<br>MODELA                                         | 210—    |              |
| 03<br>04<br>05                          | 210 IF(XK3) 220,230,230<br>C VII-D HAS LEFT BNDRY<br>220 INOF =0<br>JP3= 2                                                                                                                                                                                                                                                                                                                                          | MODELA<br>MODELA<br>MODELA<br>MODELA                                         | 230-    |              |
| 07<br>08<br>09<br>16                    | GO TO 240<br>C VII-E STILL ON BNORY.<br>230 JP3 = INDF<br>IF(ALPHA*COSPHI.GE.O.) GO TO 232<br>ALPHA=5IGN( 2,COSPHI)                                                                                                                                                                                                                                                                                                 | MODELA<br>MODELA<br>MODELA<br>APR27<br>APR27                                 | 232-    | 240          |
| 12<br>13<br>14                          | 232 CONTINUE CALL BLGCON(JP1,JP2,JP3) C VII-F TEST FOR ALFRAX                                                                                                                                                                                                                                                                                                                                                       | APR27<br>MODELA<br>MODELA                                                    | <b></b> |              |



| 284<br>285                                  | Calpha = Aphr*RD1<br>Alpha=Calpha                                                                                                                                                                                     | MODELA<br>Fol4                                                  |  |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|--|
| 86.<br>87.<br>68<br>89<br>90.<br>91.<br>92. | 360 CALL BLGCDN(JP1,JP2,JP3)     IF(ABS(APHR).GT.240.GB.ABS(VAR(2)).GT.7.) ISTART =6     IF(VAR(1).LT.0.) ISTART=6     IF(ABS(VAR(5)).GE.7.) ISTART=6     CALL DER     CALL SOER     IF(JYPP.EB.2) CALL ENVPRM RETURM | MODELA<br>10<br>10<br>10<br>MODELA<br>MODELA<br>PHISZ<br>MODELA |  |
| 94.<br>95.                                  | 999 CALL STPIT(4)<br>END                                                                                                                                                                                              | MODELA<br>MODELA                                                |  |
|                                             |                                                                                                                                                                                                                       |                                                                 |  |
|                                             |                                                                                                                                                                                                                       |                                                                 |  |
|                                             |                                                                                                                                                                                                                       |                                                                 |  |
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|                                             |                                                                                                                                                                                                                       |                                                                 |  |
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|                                             |                                                                                                                                                                                                                       |                                                                 |  |
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|                                             |                                                                                                                                                                                                                       |                                                                 |  |
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|                                             |                                                                                                                                                                                                                       |                                                                 |  |
|                                             |                                                                                                                                                                                                                       |                                                                 |  |

# SUBRØUTINE MØDELB

#### Subroutine MODELB

## Entry MODEL

#### Purpose

Subroutine MODELB governs the computation of the adjoint coefficients (partial derivatives) during the backward adjoint integration.

### Description

Subroutine MODELB performs a similar function to MODELA with the major exception that control bounding during the adjoint integration is determined by stored values of JP1 and JP3, rather than by inequality testing. MODELB is called from BNTG.

| FORTRAN | MATH              | CODE | DESCRIPTION                       |       | STORA     | SE   | SUBROUTIN                                                                                            | <u> USASE</u>                                                                                    |
|---------|-------------------|------|-----------------------------------|-------|-----------|------|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL            | 0000 | DESCRIPTION                       |       | BLÜCK     | LOC  | SUBR COD                                                                                             | E VAR                                                                                            |
| ALFMAX  | α <sub>ma</sub> χ | 1    | Maximum angle of attack           | (DEG) | /ARCDAT/( | 16)  | INBVAD M<br>MODELA I<br>MODELB I                                                                     | ALFMAX<br>ALFMAX<br>ALFMAX                                                                       |
| ALPHA   | α                 | 0    | Angle of mttmck                   | (RAD) | /AEC03 /( | 3)   | BEROCO I<br>BLGCON M<br>BL2 I<br>FNTG O<br>MAMECO I<br>MODELA M<br>MODELB O<br>REU3 O<br>VT I        | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA                             |
| APHR    | α                 | Ī    | Angle of attack .                 | (DEG) | /AEC03 /( | 2)   | AGETB3 O<br>AST3 M<br>BEROCO I<br>BLGCON O<br>GUI3A M<br>MODELA M<br>MODELB I<br>MTX3A O<br>OUT I    | APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR                                     |
| CALPHA  |                   | M    | Constant value of angle-of-attack | (RAD) | /GENF /(  | 552) | BL2 I<br>MODELA M<br>MODELB M                                                                        | CALPHA<br>CALPHA<br>CALPHA                                                                       |
| CO5 GAM | cos(7)            | Î    | See symbol                        |       | /STATE3/( | 687) | ACCEL I<br>BL4 I<br>BL8 I<br>DER3A I<br>DER3A O<br>MODELA I<br>MODELB I<br>OUT I<br>POBC I<br>POBS I | COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM           |
| COSPHI  | c ŋ s <b>ø</b>    | M    | See symbol                        |       | /AEC03 /( | 13)  | ACCEL I<br>BL4 I<br>GUI3A M<br>MODELA M<br>MODELB M<br>OUT I                                         | COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI                                         |
| COSPSI  | cos( <b>∲</b> )   | I    | See symbol                        |       | /STATE3/( | 765) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>POBC I<br>PDY3A I           | COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI                     |
| COSRHO  | c σ s(ρ)          | I    | See symbol                        |       | /STATE3/( | 707) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 M<br>MODELA I<br>MODELB I<br>OUT I<br>PDY3A I            | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO |
| COS2GM  | cos(27)           | 0    | See symbol                        |       | /STATE3/( | 757) | MODELA O                                                                                             | C0526M                                                                                           |
| COS2RO  | cοs(2ρ)           | 0    | See symbol                        |       | /STATE3/( | 756) |                                                                                                      | COS2RO<br>COS2RO<br>COS2RO<br>COS2RO<br>COS2RO                                                   |

| FORTRAN | HTAM     | COOR | DESCRIPTION                           |             | STORA     |      | SUBREUTIN                                                                                                                                |                                                              |
|---------|----------|------|---------------------------------------|-------------|-----------|------|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| SYMBOL  | SYMBOL   |      | DESCRIPTION                           |             | BLOCK     | FOC  | SUBH COD                                                                                                                                 | E VAR                                                        |
| G       | 9        | I    | Gravitational attraction              | (FT/SEC++2) | /GENF /(  | 301) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A M<br>MODELA I<br>MODELB I<br>PDY3A I<br>SDERP M                                                         | 808888888888888888888888888888888888888                      |
| GMDOT   | ,<br>7*  | 1    | Pitch rate                            | (DEG/SEC)   | /ARCDAT/( | 15)  | DER3A I<br>MODELA I<br>MODELB I<br>PROPB I<br>PROPIN I                                                                                   | TOGMO<br>TOGMO<br>TOGMO<br>TOGMO<br>TOGMO                    |
| 1611    |          | I    | Control option                        |             | /XCODES/( | 195) | ACCEL I<br>BNTG O<br>DERSA I<br>FNTG M<br>GUISA I<br>MODELA I<br>MODELB I<br>MODELB I<br>PDYSA I                                         | J611<br>J611<br>J611<br>J611<br>J611<br>J611<br>J611<br>J611 |
| JP1     |          | I    | Option flag for first governing equat | îon         | /xcodes/( | 217) | AGETB3 M<br>AST3 M<br>MODELA M<br>MODELB I<br>PROPB O<br>PROPIN O                                                                        | JP1<br>JP1<br>JP1<br>JP1<br>JP1<br>JP1                       |
| JP2     | •        | I    | Option flag for second governing equa | tion        | /XCODES/( | 218) | MODELA I<br>MODELB I<br>PROPB O<br>PROPIN O                                                                                              | JP2<br>JP2<br>JP2<br>JP2                                     |
| JP3     |          | I    | Option flag for third governing equat | ion         | /xcodes/( |      | AGETB3 0<br>AST3 M<br>MODELA M<br>MODELB I<br>OUT I<br>PROPIN 0                                                                          | JP3<br>JP3<br>JP3<br>JP3<br>JP3<br>JP3                       |
| OCORHO  | ω×COSRHO | 1    | See symbol                            |             | /STATE3/( | 708) | DER3A I<br>EQUA3 M<br>MODELA I<br>MODELB I<br>PDBC I<br>PDY3A I                                                                          | OCORHO<br>OCORHO<br>OCORHO<br>OCORHO<br>OCORHO<br>OCORHO     |
| OCOROZ  | ω×OCORHO | I    | See symbol                            |             | /STATE3/( | 769) | DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB J<br>PDY3A I                                                                                    | 0C0R02<br>0C0R02<br>0C0R02<br>0C0R02<br>0C0R02               |
| ð MGZ   | ω        | I    | Earth rotation rate                   | (RAD/SEC)   | /GLOBAL/( | 3)   | ADID3A I<br>CRASH I<br>DER3A I<br>EQUAS I<br>GEINP I<br>MODELA I<br>MODELB I<br>POBC I<br>POBC I<br>POBC I<br>POBC I<br>POBC I<br>POBC I | OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ |
| PHI     | φ        | M    | Bank angle                            | (RAD)       | /AEC03 /( | 11)  | GUI3A M<br>MODELA M<br>MODELB M<br>OUT I                                                                                                 | PHIR<br>PHI<br>PHI<br>PHI                                    |

| FORTHAN<br>Symbol | MATH<br>Symbol  | 000 | DESCRIPTION                                  |       | STORAG<br>BLUCK | E<br>LOL | SUBROUTINE<br>SUBR CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | USAGE<br>Var                                                                           |
|-------------------|-----------------|-----|----------------------------------------------|-------|-----------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| PHID              | ¢               | ī   | Bank engle                                   | (DEG) | /AEC03 /(       | 10)      | AST3 M F<br>GUI3A M F<br>MODELA M F<br>MODELB I F<br>MTX3A D F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | PHIO<br>PHIO<br>PHIO<br>PHIO<br>PHIO<br>PHIO                                           |
| R                 | R               | ī   | Radial distance from earth center to vehicle | (FT)  | /GENF /(        | 305)     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1                                         |
| RDI               |                 | Ī   | Angle to radian conversion, 01745329252      |       | /DATA /(        | 3)       | DERSA I A FNTG I A GUISA I A MODELA I A MODELB I A PADS1 D A PROPIN I A REUS I A SOINP I A SOINP I A GUISA | RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI                     |
| SINGAM            | sin(†)          | I   | See symbol                                   |       | /STATE3/(       | 688)     | BL7 I S<br>BL8 I S<br>DER3A I S<br>EQUAS O S<br>MODELA I S<br>MODELB I S<br>POBC I S<br>POYSA I S                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM           |
| SINPHI            | sìn∲            | m   | See symbol                                   |       | /AEC03 /{       | 12)      | ACCEL I S<br>BL4 I S<br>MODELA M S<br>MODELB M S                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | SINPHI<br>SINPHI<br>SINPHI<br>SINPHI<br>SINPHI                                         |
| SINPSI            | sin( <b>∲</b> ) | Î   | See symbol                                   |       | /STATE3/{       | 704)     | BL7 I S<br>BL8 I S<br>DER3A I S<br>EQUAS O S<br>MODELA I S<br>MODELB I S<br>POBC I S                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI |
| SINAHO            | s i n (ρ)       | 1   | See symbol                                   |       | /STATE3/(       | 706)     | BL7 I S<br>BL8 I S<br>OER3A I S<br>EQUAS O S<br>MODELA I S<br>MODELB I S<br>OUT I S<br>POBC I S                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | SINRHO    |
| SIN2RO            | sin(2p)         | 0   | See symbol                                   |       | /STATE3/(       | 755)     | BL4 I S<br>BL7 M S<br>BL8 M S<br>MODELA 0 S                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 5 I N2RO<br>5 I N2RO<br>5 I N2RO<br>5 I N2RO<br>5 I N2RO                               |

| FORTRAN | MATH           | COOE DESCRIPTION                                         | STORAGE SUBROUTINE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                              |
|---------|----------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| SYMBOL  | SYMBOL         | DESCUTLITON                                              | BLOCK LOC SUBR CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | VAR                                          |
| SQRT    |                | F Square root function                                   | CRASH F SOUTOE F F SOUTOE F F SOUTOE F  | OGRATTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT     |
| V       | •              | I Relative velocity ('FT/                                | SEC) /STATE3/( 1) ACCEL I V ADICB3 G V ADICB3 G V ADJUST M V AGETB3 O V AST3 I V BL4 I V BL7 I V BL8 I V CON3 I V CON5 I | ARRARA AR      |
| MOSK    |                | O Working array, contains TOPEN1, TOPEN2, and PHI        | WT /STS /( 3) ADEQ3A I W FNTG I W MODELB D W MTX3A I W SDINP M W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | IORK<br>IORK<br>IORK<br>IORK<br>IORK<br>IORK |
| XKGAM   | k,             | M Algebraic equation used in vertical rise and pitchover | modela m x                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | KS<br>KGAM<br>KGAM                           |
| XKPS    | kψ             | M Algebraic equation used in vertical rise and pitchover | MODELA M X<br>MODELA I X<br>MODELB M X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | KPS<br>KPS<br>KPSI<br>KPS<br>KPSI            |
| XKP\$I  | k <sub>ø</sub> | I Algebraic equation used in vertical rise and pitchover | MODELA M X<br>Modela I X<br>Modelb M X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | KPS<br>KPS<br>KPSI<br>KPS<br>KPSI            |

```
MEDELB

 123 45 67 8 90 123 45 
   COMPUTES ADJOINT COEFFICIENTS ( D SUB Y . F )
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   DESSSS

COODDEESSS

COODDEESS

CO
   , MBC(20)
   , MBC(20)

, DTP

, DS

, CS

, SUMSQ

, TR(9)

, M

, OMP

, TBU(26)
   MACHY
  DRAGA
ISPF
ULFTA
CODAE
SID
  DBR
ULFT
XMCGR
CALPHA
XCG
  ULFTV
XMCGA
COE
ZCG
   JISP
JULFTR
XMCGM
DELTAE
  XMCSV
CT
SIDAE
   *XMCG
*CULFT
   +COD
  / GÉNF /
XJR
, ÍRATED
   COMMON
+XJV
+FRATED
  SENF
SENF
  ,GH
  GAMMAD,
  , XKP
   , XKG
   P3 XK1
XK3T XK1D
XK3A XK1V
XK3A XK1V
XK3A XK1D
XK3B XK1D
XK3U XK1M
PP
LIFTA LIFTA
FTV IRATED
   , XK3
, XK3D
, XK3V
, XK3V
, XK3P
, XK3M
, DPDY(3,8)
MACHR,
   , XK2
, XK2D
, XK2V
, XK2P
, XK2O
, XK2H
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   SENF
SENF
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GENF
GENF
  MACH,
   FRAT
SENF
SENF
DATA
44445555555555566666667777777
  EGUIVALENCE (1LF), TPHI
COMMON/DATA/
PI RAD
FTNM CAR
COMMON/STATE3/
*VAR(14) DVAR (14)
*XL(9,9) YDP(20,9),
*SINPSI COSPSI
*VDV SDV
*UDV YDR
*UDR YDR
*UDR
*UDR
*UDR
*PDD
*PDD
*ADR
*PDD
*PDD
*PDD
**REAL MDM *MDV
*SINPSI
*SINPSI
**COMMON/STATE3/
*SINPSI
*COMMON/STATE3/
*SINPSI
**COMMON/STATE3/
**SINPSI
**COMMON/STATE3/
**SINPSI
**COMMON/GLOBAL/
**GR
  ,UMF
,JDP3
   DATA
DATA
STATE3D
STATE3D
STATE3D
STATE3D
  ,RDI
  ,SC
,JOP2
   TAPF
JOP4
  ,JÕP1
   (14), VARL (99)
0,9), VDS (20,9)
1 , SINRHO
0,04EGA2
, RDV
, BDV
, BDV
, BDR
, GDR
, GDR
, GDR
, GDR
   , YO( 9 )
, SINGAM
, OCORHO
  , DVARL(99)
, COSGAM
, COSRHO
   ,SVY(10)
,SAVBP(15)
,OCORO2
   STATE 3D
   PDV
PDS
PDR
PBM
VOO
  ,004
,006
,008
,009
,600
  , ADV
   STATE3D
STATE3D
STATE3D
  RDS
MOR
ADM
UDP
HTDR
   STATESD
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STATESD
GLOBAL
  ,C0526A
  SLOBAL
GLOBAL
GLOBAL
GLOBAL
   RETAP
  ,ALPHA ,VDA
PHIO ,PHIO
POPH ,XLAMA(9)
FK ,XCGM
,CMAM ,CMM ,CMO
   ,PDA
,SINPHI
,CDO
,CLGM
,FKM
   AEC03
AEC03
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AEC03
```

20 OCT 72 6.01-46

```
1 G --
1112
1113
1114.
1116
1116
1117
119
120
121
  20-
                   10 PHI= PHID + RDI
SINPHI = SIM(PHI)
COSPHI = COS(PHI)
II COMPUTE DECISION VECTOR
122
123
124.
125
   MODELB
MODELB
MODELB
             £
  MODELB
                   20 CALL BLGCON(JP1,JP2,JP3)

III COMPUTE PARTIALS OF DECISION VECTOR
CALL BLGCNV(JP1,JP2,JP3)

III-A SET HULTIPLIER TO 0 IF NON-OPT CONTROL
WORK(11)=1.

IF(JP3.GT.2) WORK(11)=0.

IF(JSII.LE 10) WORK(11)=0.

IF(ABS(APHR) GE.ALFMAX) WORK(11)=0.
   P014
M00ELB
126.
127.
128
129.
130
131
132
133.
            С
   MODELB
PO14
PO14
PO14
APR
APR
PO14
            C
   30-
135.
136
137
138.
139
                          CONTINUE
IV COMPUTE ADJOINT COEFFICIENTS
CALL PDY
RETURN
  APR
MODELB
MODELB
MODELB
             C
                           END
  MODELB
```

# SUBRØUTINE MØMJ

## FUNCTION MOMJ

## Entry MOMG

## Purpose

MOMJ sets the internal stopping variable flag given the input variable code.

## Description

MOMJ is called from SDINP during the boundary condition scan.

MOMJ

```
FUNCTION MONJ( 1)
  SETS STOPPING VARIABLE FLAS USING INPUT CODE
                       DIMENSION J(36)

DATA (J(N),N=1,36) /2,3,4,5,6,7,8,9,1,99,99,12,13,14,15,16,17,18,

1 19,26,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36/

ENTAY ROME

L= IABS(I)

IF(L GT.36) 80 TO 10

K= ISIGN(I,I)

IF(J(L),EQ.59) 80 TO 10

MONJ = K* J(L)

RETURN
   16-
   16-
                  10 WRITE(6,20) L
MORJ=99
20 FORMAT(3X,110,37H IS AN ILLEGAL STOPPING VARIABLE CODE)
RETURN
END
   MONJ
MONJ
MONJ
MONJ
MONJ
```

20 DET 72 G 01-46

# SUBRØUTINE MPSI

### FUNCTION MPSI

## Purpose

MPSI returns the internal constraint or payoff variable code given the input variable code.

## Description

MPSI is called mainly from SDINP.

MPSI

```
1. C
3. C
4. 5. 6. 7. 8. 9. 10
11 12 13. 14. 15. 16.
                                      FUNCTION MPSICE)
   SETS CONSTRAINT CODE FROM INPUT CODE

DIMENSION J(36)

DATA (J(N), N=1, 36)/99, 2, 3, 4, 5, 6, 7, 8, 1, 16, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 36, 31, 32, 33, 34, 35, 36/

IF(I, 6T, 36, OR, 1, LT, 1) 60 TO 10

JJ= J(I)

IF(JJ, EQ, 99) 60 TO 10

MPSI= JJ

RETURN

D WRITE(6, 20) I
                            LO WRITE(6,20) I
20 FORMAT(3x,13,30H IS AN ILLEGAL CONSTRAINT CODE )
MPSI= 99
RETURN
END
```

# SUBRØUT I NE MTX3A

#### Subroutine MTX3A

### Entry Points

MTX and MTX1

## Purpose

MTX computes the TR vector during closed-loop control. MTX1 computes control and parameter changes during forward trajectory.

### Description

The equations for calculating TR and the control and parameter changes are described in Sections 12.1 and 15.1 of Volume I. MTX3A entry points MTX and MTX1 are called from FNTG, and MODELA respectively.

| FORTHAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                                 |       | S T OR A<br>BLOCK | LOC  | <u>SUBROU</u><br>SUBR                                                                                                       |                                                                                             |                                                                    |
|-------------------|----------------|------|-------------------------------------------------------------|-------|-------------------|------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| A                 | А              | 1    | Control Integral matrix                                     |       | /GENF /(          | 109) | ADEQ3A<br>ADIC83<br>BGET3<br>BNTG<br>BSTO3<br>MTX3A<br>MTX3A<br>PTX02<br>SDINP<br>TRAN3                                     |                                                                                             | 999999                                                             |
| APHO              | °old           | 1    | Angle of attack from last nowinal trajectory                | (DEG) | /AEC03 /f         | 1)   | AST3<br>FNTG<br>MTX3A<br>OUT<br>PROPB<br>PROPIN                                                                             | M<br>I<br>I<br>I<br>O                                                                       | APHO<br>APHO<br>APHO<br>APHO<br>AEZRO<br>AEZRO                     |
| APHR              | α              | 0    | Angle of attack                                             | (DEG) | /AEC03 /(         | 2)   | AGETB3 AST3 BEROCO BLGCON GUI3A MODELA MODELB MTX3A OUT                                                                     | M<br>I<br>O<br>M<br>M                                                                       | APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR       |
| В                 |                | M    | Temp storage for a matrix also called B matri               | x     | /GENF /(          | 208) | ADICB3<br>MTX3A<br>TRAN3                                                                                                    | ظ<br>ጠ<br>ጠ                                                                                 | COTI<br>B<br>COTI                                                  |
| DALP              | δ∝             | W    | Angle of attack correction                                  |       | /MTX3A /(         | + )  | AEXTM                                                                                                                       | W                                                                                           | DALP                                                               |
| DCON              | ďΨ,            | I    | Asked for correction in constraint misses and payoff vector |       | /GENF /(          | 289) | CON3<br>MTX3A<br>PAY02<br>TEST<br>TOPM<br>TRTOSZ                                                                            | 0<br>M<br>M<br>I                                                                            | DCON<br>OCON<br>DCON<br>DCON<br>DCON<br>DCON                       |
| DPAR              | δр             | M    | Adjustable parameter corrections                            |       | /PARAM /(         | 264) | ADJUST<br>MTX3A<br>TOPM                                                                                                     |                                                                                             | DP AR<br>DP AR<br>DP AR                                            |
| DPHI              | δφ             | ш    | Bank angle correction                                       |       | /MTX3A /(         | ¥ )  | MTX3A                                                                                                                       | ы                                                                                           | DPHI                                                               |
| IND               |                | I    | Flag indicates whether on first nominal traje (IND=1)       | ctory | /XCODES/(         | 141) | AST3<br>BGET3<br>FNTG<br>GUI3A<br>MTX3A<br>PROPIN                                                                           | I<br>I<br>M<br>I<br>I<br>I                                                                  | IND<br>IND<br>IND<br>IND<br>IND<br>IND                             |
| 1611              |                | 1    | Control option                                              |       | /XCODES/(         | 195) | ACCEL<br>BNTG<br>DER3A<br>FNTG<br>GUI3A<br>MODELA<br>MODELB<br>MTX3A<br>PDY3A                                               | I                                                                                           | J611<br>J611<br>J611<br>J611<br>J611<br>J611<br>J611               |
| NCN<br>30 OCT 72  | C 03-44        | 1    | Number of elements în dŷ                                    |       | /XCODES/(         | 160) | ADEQ3A<br>ADIC3A<br>ADIC3A<br>ADID3A<br>ADJUST<br>AST3<br>BNTG<br>BNTG<br>BNTX3A<br>OUT<br>PAYO2<br>TEST<br>TRAN3<br>TRIOSZ | I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I | NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN<br>NCN |



| FORTHAN<br>Symbol | MATH<br>Symbol   | CODE   | DESCRIPTION                                                                                                      | S T D<br>B L D C K | RAGE<br>LOC | SUBROUTINI<br>Subr codi                                                                                                            |                                                                       |
|-------------------|------------------|--------|------------------------------------------------------------------------------------------------------------------|--------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| NEQ ,             | ٠                | I Numb | eer of integrated states                                                                                         | /xcodes            | /( 162)     | ADICBS I<br>ABICBS I<br>ADICBS I<br>AGETS I<br>BGETS I<br>BTXSA I<br>OUT I<br>REUS I<br>SDERS I<br>SDERS I<br>TOPM I<br>TYREFS I   |                                                                       |
| NPA               |                  |        | ling count of number of adjustable parameters to erturbed on remainder of trajectory                             | o /PARAM           | /( 14)      | ADJUST M<br>FNTG I<br>MTX3A I<br>TOPM D                                                                                            | RA 9N<br>A 9N<br>A 9N<br>A 9N                                         |
| NP AR A           |                  |        | per of adjustable parameters in trajectory<br>lem.                                                               | /PARAM             | /( 13)      | ADJUST I BNTG I FNTG I MTX3A I PAY02 I PRMSET I SDINP M STAU I TEST I TOPM D                                                       | NP ARA |
| PHID              | ¢                | O Bani | cangle (DEG                                                                                                      | ) /AECO3           | /( 10)      | AGETB3 O<br>AST3 M<br>GUI3A M<br>MODELA M<br>MODELB I<br>MTX3A O<br>OUT I                                                          | PHID<br>PHID<br>PHID<br>PHID<br>PHID<br>PHID<br>PHID                  |
| PHIO              | ø old            | I Bank | angle from last nominal trajectory                                                                               | /AECO3             | /( 9)       | AST3 M<br>MTX3A I                                                                                                                  | PHID<br>PHID                                                          |
| RAD               |                  | I Radi | an to angle conversion, 57.29577951                                                                              | /BATA              | /( 2)       | BEROCO I<br>BLGCON I<br>ENVPRM I<br>EQUAS I<br>FNTG I<br>GUISA I<br>MODELA I<br>MOTSA I<br>OUT I<br>PADIN I<br>SDINP I<br>TRTOSZ I | DEG<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD    |
| SPARB             | s <sup>¥</sup> i | (Cor   | rix of adjustable parameter sensitivities.<br>ntains only elements corresponding to parameter<br>to be adjusted) | /PARAM             | /( 144)     | ADJUST O<br>MTX3A I<br>TOPM D                                                                                                      | SPARB<br>SPARB<br>SPARB                                               |
| S21NV             | [55]             | •      | ameter sensitivity contribution to A matrix                                                                      | /PARAM             | /( 276)     | G TZULDA<br>M AEXTM<br>M SGYA9<br>G M9GT                                                                                           | S21NV<br>S21NV<br>S21NV<br>S21NV                                      |
| TR                |                  |        | tor modifier of impulse response function in<br>trol calculation                                                 | /GENF              | /( 322)     | MTX3A M<br>TRAN3 M                                                                                                                 | TR<br>TR                                                              |

| FORTRAN | MATH                                  | CODE                             | DESCRIPTION                                 |            | STORAC    |      | SUMPOUT INC                                                                                                           |                                                                    |
|---------|---------------------------------------|----------------------------------|---------------------------------------------|------------|-----------|------|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| SYMBOL  | SYMBOL                                | ,                                | DESCRIETION                                 |            | BLOCK     | LOC  | SUBR CODE                                                                                                             | VAR                                                                |
| VAR     | V                                     | I Relative velo                  | city                                        | (FT/SEC)   | /STATE3/( | 1)   | MODELB I<br>MTX3A I<br>OUT I                                                                                          | VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR |
| WORK    |                                       | I Working array                  | , contains TOPEN1, TOPEN2,                  | and PHIWT  | /STS /(   | 3)   | ADEQ3A I<br>FNTG I<br>MODELB O<br>MTX3A I<br>SDINP M<br>TEST M                                                        | WORK<br>WORK<br>WORK<br>WORK<br>WORK                               |
| uTP     | [ Y ]                                 | I Adjustable pa<br>order accordî | rameter diagonal meighting<br>ng to IPOINT. | matrix     | /PARAM /( | 132) | MTX3A I<br>PAYO2 I<br>SDINP 0<br>TOPM D                                                                               | WTP<br>WTP<br>WTP                                                  |
| ХL      | $\lambda^{\Psi_i\Omega}$ J            | I Matrix of adj                  | oint variables                              |            | /STATE3/( | 246) | ADEQ3A M<br>ADICB3 M<br>ADIC3A M<br>ADID3A M<br>AST3 M<br>BGET3 D<br>BST03 I<br>MTX3A I<br>OUT I<br>STAU I<br>TRAN3 M | XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL                 |
| XLAMA   | $V_{\hat{\Phi}^1 \hat{\Omega}^1}$     | I impulse respo<br>øith angle of | ense function column vector<br>attack       | associated | /AEC03 /( | 16)  | ADEQ3A M<br>ADIC3A D<br>AST3 D<br>BGET3 D<br>BSTD3 M<br>MTX3A I<br>TRAN3 M                                            | XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA        |
| XLAMP   | $V_{\tilde{\Lambda}^1 U^{\tilde{1}}}$ | I Impulse respo<br>ø≀th bank ang | inse function column vector<br>le           | associated | /AEC03 /( | 25)  | ADEQ3A M<br>ADIC3A D<br>AST3 D<br>BGET3 D<br>BST03 M<br>MTX3A I<br>TRAN3 M                                            | XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP        |
| Y0      | yold                                  | I State vector                   | of nominal trajectory                       |            | /STATE3/( | 227) | AST3 D<br>MTX3A I                                                                                                     | ¥0<br>¥0                                                           |

| e                | SUBROUTI                |                        |                             |                  |                |                                  | Š           |
|------------------|-------------------------|------------------------|-----------------------------|------------------|----------------|----------------------------------|-------------|
| C                | ENTRY                   | MTX COMPUTE            |                             | OR DURING        | CLOSED LOG     |                                  | 0           |
| C<br>C<br>C<br>C | ENTRY                   | NTX1 COMPUTE           | CONTROL                     | AND PARAMET      | TER CHANGES    | SON TRAJECT                      | 1. Q        |
| -                | COMMON/S                | TATES/                 |                             |                  |                | 5 HP ( 1 A )                     | S           |
|                  | *VAR(14)                | PI) RAVE,              | ), VARL (99)<br>,YDS (20,9) | DVARL(99)        | SINGAM         | ,5VY(10)<br>,5AVBP(15)           | , s         |
|                  | +XL(9,9)<br>+SINPSI     | ,CDSPS1                |                             | , COSRHO         | ,000640        | ,ocoro2                          | , 3         |
|                  | *SYBY (                 | S \ AMEEA              |                             |                  | -              | *                                | ~ 5         |
|                  | *VDV                    | , VDG                  |                             | , MBV            | ,PDG           | , ODY                            | , 5         |
|                  | *UDV<br>*UDG            |                        | , GDS<br>, GDR              | , ADS<br>, ADR   | PDR            | ,006<br>,00R                     | , ,         |
|                  | *UDR                    |                        | GHM                         | . 666            |                | . VUP                            | ; §         |
|                  | *GDP                    |                        | .007                        | .002             | , v00          | ,600                             | , 5         |
|                  | *PDO<br>REAL MOM        | ,UDO<br>MOV, MOR       | ,HTDV                       | , HTDR           |                |                                  | · \$        |
|                  | COMMON/S                | TATES/                 |                             |                  |                |                                  | 3           |
|                  | ≠SIN2B0                 | .COS2RO                | ,COS26M                     |                  |                |                                  | 5           |
|                  | COMMON/AI               | EC03/                  |                             |                  |                |                                  |             |
|                  | +APHO<br>+SINA          | APHR<br>COSA           | ,ALPHA<br>,PHIO             | ,VDA<br>,PHID    | , GDA<br>, PHI | ,PDA<br>,SINPHI                  |             |
|                  | +COSPHI                 |                        | PBPR                        | 21 2001 3 1      |                | , CDO                            |             |
|                  | +CDOM                   | EUD                    |                             |                  | 7 C S 15       | ,ULOM                            |             |
|                  | *CM                     | 1.400                  | .CMAR .URF                  | i.UMU            | CMOM           | ,FKM                             | . A         |
|                  | ♥CLAM<br>♥CD            | CL                     | ,CLA<br>,CDM                | , CL#I           | ,              |                                  | Á           |
|                  | COMMON/S.               | rs/                    | · =                         |                  |                |                                  | 5           |
|                  | -DPAY                   | PHIN                   | , WORK (20)                 | NHDS             | ,IPC (1        | 7),NITER<br>20)<br>:DVARL(50),J. | . š         |
|                  | *MNGA(26,2              | 2),MNGP(20,2           | ) AR(200),                  | ÍAD(20) ,IM      | (P(20),15V(2   | 20)                              | <b>´</b> \$ |
|                  | DIMENSION               | 9 RR(9),3](9           | ), DELY(7), 8               | (9,9)            |                | DUADICED'S I                     | 5           |
|                  | COMMON/D                | YCEL DYAKLI 30<br>Maa' | 3, KK 3, C D WAR            | C(40), DELY      | 1,(5011,8),(   | DANKEL 20 1'2'                   | 1) f<br>0   |
|                  | *PI                     | ,RAD                   | ,RDI                        | ,5C              | , UAF          | ,TMPF                            | . ŏ         |
|                  | *FTNR                   | ERR                    | ,JOP1                       | JOP2             | JOPS           | ,JOP4                            | , c         |
|                  | COMMON /                |                        |                             |                  |                |                                  | . 3         |
|                  | *ITQ (1                 | 9),ICOR (20            | ),ITI<br>,NCHST             | , INTB<br>, NSB  | ,1618(20,7     | ,NICNB                           | ), )        |
|                  | *120P                   | TONE                   |                             | IFAR             |                | PAD .                            | į           |
|                  | +10PE#                  |                        |                             | 1551             |                | LISTARI                          | , x         |
|                  | *ITCT                   |                        | - 1 V A R                   |                  | LPS            | 15                               | , x         |
|                  | ≠KOP<br>≠NCN            | ,KPST<br>,NEQB         | , NEQ                       | K S I            | NAD<br>NPH     | . NERSE                          | , x         |
|                  | *NST                    | IPST                   | IPKINI                      | ,NOP<br>.ISTN    | LPHN           | ISTNB                            | . X         |
|                  | #IPHNB                  | LIBLKI                 | IBLK2                       | , istor          | ISTPP          | .L                               | . x         |
|                  | *IFOB                   | MB                     | . 1. 8.                     | RH.              | MPHP           | RPHK                             | , ,         |
|                  | *NCTIN                  | ,NEUF .ILA             | B(8), JPRP, J               | GII, MTT, MPI    | (N(20), JP1,.  | JP2,JP3                          | Ž           |
|                  | COMMON/6!<br>+OMG( 20 ) | DMGP:20 2              | ) VARD(9)                   | ,TOL(9)          | ,SVAR(10)      | , MDC(20)                        | . 8         |
|                  | #A(9,9)                 |                        | BCDN(9)                     | 1301114 9        | ) DEDMESS      | กรอ                              | . 6         |
|                  | +DTS                    |                        | 16                          | nocn             | 0              |                                  | , 8         |
|                  | *R                      |                        |                             |                  |                | . (3                             | , 6         |
|                  | +VNU<br>+5VSQ           | .rus                   | ROR<br>TIMES                | ,65H<br>TOD      | , VNH<br>Tas   | ,50050                           | , 6         |
|                  | *TST(20)                | TIMEPH<br>TPH (20      | ),DIS(20)                   | 11111201         | , T            |                                  | ,           |
|                  | +TLP1(20)               | .1651 (20              | )_BIP1(20)                  | BIS1(70)         | - 3 1 ME       | .unr                             | ΄. ε        |
|                  | +TIMPR                  |                        | TRAGE.                      | . I A X          | .TBUAN         | . (80(20)                        | ΄, ξ        |
|                  | +AE<br>+OR              | FP<br>,QV              | ,FPOLO<br>,FVAC             | .FPB             | MACHR          | , MACHV                          | , <u>e</u>  |
|                  | +un<br>+LIFTR           | LIFTA                  |                             | LIFTY            | DRAGR          | . DRAGA                          | ā           |
|                  | *                       | LIFTN                  | DBR                         | n R              | ISP            | fcor                             | ; }         |
|                  | *                       |                        | ULFI                        |                  | 111 P 1 M      | HIFEA                            | , (         |
|                  | +XMCG                   | , XWCBA                | , XMCGR                     | .XMCGA           | XACCA          | LUUAE                            | . 8         |
|                  | *CULFT                  | CT<br>SIDAE            | .CALPHA                     | , CUE            | DELTAE         | ,SIB                             | , 6         |
|                  | *COD<br>COMMON /        | GENF /                 | XCG                         | ,zce             | ,xı            |                                  | Ę           |
|                  | +XJV                    | XJR                    | , 6H                        | , SAMMAD         | , XKG          | , XXP                            | . 8         |
|                  | +FRATED                 | TRATED                 |                             | •                | •              |                                  | ΄ ξ         |
|                  | *P1                     | . 63                   | , P3                        | ,XK1             | , XK2_         | , XK3                            | , 9         |
|                  | *XK1T<br>*XK1A          | , XK2T<br>, XK2A       | , XK3T<br>, XK3A            | , XK10<br>, XK1V | XX20<br>XX2V   | , XX3D<br>, XX3V                 | . 6         |
|                  | *XK16                   |                        |                             | 11112            |                |                                  | •           |
|                  |                         | ,XK2R                  | , XK3R                      | ,xxio            | , XK20         | , XK30                           | : 8         |
|                  | *XK1A                   |                        |                             |                  |                |                                  |             |

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```
76.
77
78.
79.
80
81.
  GENF
GENF
FRAT
  ,PO ,OFDY(3,8) MACH, MACH,
   SENF
SENF
PARAM
  CDMMON/PARAM/
*IPDINT(12),NPARA,NPA SPARA(9,12),HTPD (9),HTP (12),
*SPARB(9,12),PARA(12),DPAR(12),SZINV(9,9)
*,DELP(9)
ENTRY MTX
                                82.
83.
84.
85.
   PARAM
   PARAM
PARAM
MTX3A
                                86.
87.
88.
89.
90.
91.
   MM03
COMN
COMN
AEXTH
AEXTH
   C
   I COMPUTE CHANGE IN STATE
00 10 I=1 NEQ
10 DELY(I) = VAR(I) - YO(I)
                          d
  II TEST FOR PARAMETER SENSITIVITIES

AND IF PRESENT COMPUTE CONTRIBUTION TO A MATRIX
IFCNPA.EQ.O) GO TO 40

DO 30 I=1,NCM
SS=0

DO 20 J=1,NPARA
SS= SS + SPARB(I,J)*SPARB(N,J) / MTP(J)
20 CONTINUE
SZINV(I,N) = SS
30 CONTINUE
   COMM
COMM
MIXSA
MIXSA
MIXSA
MIXSA
MIXSA
MIXSA
MIXSA
MIXSA
   40-
                                93.
94.
95.
96.
97.
98.
                              101.
102.
103
104
   COMM
COMM
COMM
   III CHECK FOR ZERO DIAGONAL ELEMENT IN A AND S
MATRICES AND SET FLAGS
   #U =0

D0 &0 I=1 NCN

IF(ACI I) EQ.0 AND S2INV(I,I) EQ.0.) 60 TO 50

JJ(I)=1
   AEXTR
AEXTR
AEXTR
                               105.
   40 NO =6
                               106
107
108.
  AEXTA
   NO =NO +1
SO TO 60
  AFETA
                               110.
   66-
   50 JJ(1) =0
   AEXTA
                              111
                              112
113.
114.
115.
116.
117.
118.
   ATX3A
COMM
COMM
MTX3A
MTX3A
MTX3A
  60 CONTINUE
   CONTINUE
IV COMPRESS A MATRIX AND STORE IN B WITH
PARA. SEMS. CONTRIBUTION
IA =0
00 80 I=1,NCM
IF(J)(I).EQ.6) SD TO 80
   80-
   IA = IA+1

IB = IA -1

ID 70 J=I, NCN

IF( JJ(J).EQ.0) GO TO 70

IB= IB+1

B(IA,IB) = A(I,J) - S2INV(I,J)
   AEXTH
AEXTH
AEXTH
AEXTH
   70-7
                               122.
123.
  ATISA
  70 CONTINUE
  AEXTM
                               124.
                             125.
126.
127.
128.
129.
   BG CONTINUE
V INVERT A
IF(NO.GT.1) GO TO 90
B(1) 1)= 1./B(1,1)
GO TO 120
  AEXTA
  ſ.
  EDAN
ATX3A
ATX3A
  AEXTR
  L126-
                              130
131
132
133
134
135
136.
137
138.
  90 CONTINUE
CALL SYMMAT( B, 40, IER)
IF(IER. NE. 0) 80 T0 240
RESTORE MATRIX
DO 110 I=1, MO
DO 100 J=I, MO
100 B(I, J)= B(J, I)
110 CONTINUE
   MEXIM
MEXIM
MEXIM
AEXIM
AEXIM
AEXIM
  246-
   ε
                         6
  MTX3A
COMM
COMM
  VI CALCULATE CORRECTED CONSTRAINT MISS VELTOR
BASED ON CURRENT EFFECT OF CHANGE IN STATE
                               140.
  COMM
                           141.
142.
143.
144
145.
146
147
  AEXTR
AEXTR
AEXTR
  120 KK=0
D0 140 I=1, NCM
IF(JJ(I).E0 0) G0 T0 140
KK=KK+1
RR(KK) = DCON(I)
D0 130 JP =1, NEQ
136 RR(KK) = RR(KK) - XL(JP,I)+ DELY(JP)
  146
  AEXTA
AEXTA
AEXTA
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```

```
140 CONTINUE

VII COMPUTE TR VECTOR

DO 160 I=1, MO

TR(1)=0.

DO 150 JP=1, MO

150 TR(1)= TR(1) + B(I,JP)*RR(JP)

160 CONTINUE

RETURN

ENTRY MTX1

IF(IND.EQ.1)RETURN

KK=0

DPHI =0.

DALP =0.

VIII ***

CALCULATE CONTROL CORRECTION

DO 180 I=1, MCM

IF(J)(1).EQ.0) SD TD 180

KK=KK+1

DALP = DALP + XLAMM(I)* TR(KK)

DPHI = DPHI + XLAMM(I)* TR(KK)

1 * WORK(10)

180 CONTINUE
148.

148.

148.

150.

151.

152.

155.

155.

156.

157.

158.

160.

162.

163.

164.

164.

165.

166.

167.

166.

167.

166.
   MTX3A
COMM
MTX3A
MTX3A
MTX3A
MTX3A
MTX3A
MTX3A
   RETURN
   MTX3A
PO143AA
MTX3AA
MTX3AA
MTX3AA
MTX3AA
MTX3AA
MTX3A
  186-
   MTX3A
MTX3A
COMM
COMM
MTX3A
MTX3A
MTX3A
MTX3A
MTX3A
               170.
171.
172.
173.
174.
175.
176.
177.
178.
179.
180.
  180 CONTINUE
IF(NPARA.EQ.O) 60 TO 210
IF(NPA.EQ. 0) 60 TO 210
  210-
210-
  190-
  KK=KK+1

DPAR(I) = DPAR(I) - SPARB(KK,I) + TR(KK) /WTP(I)
                182
183.
   AEXTH
AEXTH
   190 CONTINUE
200 CONTINUE
   210 CONTINUE
IF(JGII.LE-10) RETURN
APHR = APHO + DALPSRAD
PHID= PHID+ DPHI * RAD
IF(ABS( DPHI).LT..26) RETURN
PHID=PHIO+SIGN(.26,DPHI) * RAD
AFTHRM
  MTX3A
P014
MTX3A
MTX3A
MTX3A
APR
MTX3A
                184-
185
186
187-
188-
189-
190-
191
   RETURM
220 CALL IPR(10HA SINGULAR, A, I, 81,0)
   230 CALL STPIT(4)
   MTX3A
                 192
   240 CALL IPRIIONS SINGULAR, B, I, 81, 0)
GO TO 230
END
   AEXTM
AEXTM
                 193.
194.
195.
   236-
  MT X3A
```

# SUBRØUT I NE ØUT

#### Subroutine OUT

#### Entry OUTERR

#### Purpose

Subroutine OUT puts data into print array AP in preparation for printing a trajectory block.

### Description

Subroutine OUT controls the computation of auxiliary print quantities (Section 8, Volume I) and checks print options. It loads all desired data into the print array AP and then calls subroutine PRINT which does the formatted printing, heading and labeling. Entry OUTERR is called whenever a control divergence occurs. This entry prints the message:

### :::\*CONTROL DIVERGENCE (SEE NEXT PRINT BLOCK)

And then continues with the remaining code in subroutine OUT to print a standard trajectory block. Subroutine OUT is called from FNTG.

| FORTRAN<br>Symbol | MATH<br>Symbol       | CODE | DESCRIPTION                                  |       | STORA:<br>BLOCK | LOC  | <u> 5 UBROU</u><br>5 UBR                                                          |                       | USAGE<br>VAR                                                                                     |
|-------------------|----------------------|------|----------------------------------------------|-------|-----------------|------|-----------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------|
| <del></del>       | ·····                |      |                                              | ~~~~  |                 |      |                                                                                   |                       |                                                                                                  |
| AINCL             | I                    | I    | Orbital inclination                          | (RAD) | /ORBIT /C       | 7)   | OUT<br>PDBC                                                                       | I<br>M                | AINCL<br>AINCL                                                                                   |
| ALT               | h                    | 1    | Altitude                                     |       | /STATE3/(       | 3)   | EQUA3<br>OUT<br>POBC                                                              | I<br>I<br>I           | ALT<br>ALT<br>ALT                                                                                |
| ANOMLY            | \$                   | 1    | True anomoly                                 | (RAD) | /ORBIT /(       | 13)  | OUT<br>PDBC                                                                       | I<br>M                | ANDMLY<br>ANOMLY                                                                                 |
| AP HO             | °old                 | I    | Angle of attack from last nominal trajectory | (DEG) | /AEC83 /(       | 1)   | AST3<br>FNTG<br>MTX3A<br>OUT<br>PROPB<br>PROPIN                                   | M<br>I<br>I<br>I<br>O | APHO<br>APHO<br>APHO<br>APHO<br>AEZRO<br>AEZRO                                                   |
| APHR              | α                    | I    | Angle of attack                              | (DEG) | /AEC03 /(       | 2)   | AGETB3 AST3 BEROCO BLGCON GUI3A MODELA MODELB MTX3A OUT                           | H<br>I<br>O<br>H      | APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR<br>APHR                                     |
| APOGEE            | R <sub>a</sub>       | I    | Apogee radius                                | (FT)  | /ORBIT /(       | 11)  | DUT<br>PDBC                                                                       | I<br>O                | APOGEE<br>APOGEE                                                                                 |
| ARGP              | ø <sub>p</sub>       | I    | Orbital argument of perigee                  | (RAD) | /ORBIT /(       | 8)   | OUT<br>PDBC                                                                       | I<br>M                | ARGP<br>ARGP                                                                                     |
| ASCNOD            | Ω                    | 1    | Longitude of ascending node                  | (RAD) | /ORBIT /(       | 9)   | OUT<br>PDBC                                                                       | I<br>M                | ASCNOB<br>ASCNOD                                                                                 |
| CD                | $c_D$                | I    | Drag coefficient                             |       | /AEC03 /(       | 52)  | BEROCO<br>OUT<br>VT                                                               |                       | CD<br>CD                                                                                         |
| CL                | cr                   | I    | Lift caefficient                             |       | /AEC03 /(       | 49)  | BEROCO<br>OUT<br>VT                                                               | M<br>I<br>I           | CL<br>CL                                                                                         |
| COD               | cos(8 <sub>E</sub> ) | I    | See symbol                                   |       | /GENF /(        | 556) | EL2<br>OUT<br>VT                                                                  | I<br>I<br>M           | COD<br>COD<br>COD                                                                                |
| COSA              | cos∝                 | I    | See symbol                                   |       | /AEC03 /(       | 8)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>OUT<br>VT                             | IIIIIII               | COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA                                             |
| CBSGAM            | COS(7)               | Ĭ    | See symbol                                   |       | /STATE3/(       | 687) | ACCEL<br>BL4<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>OUT<br>POBC<br>PDY3A | I                     | COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM |
| COSPHI            | cσsφ                 | I    | See symbol                                   |       | /AEC03 /(       | 13)  | ACCEL<br>BL4<br>GUI3A<br>MODELA<br>MODELB<br>OUT                                  | I<br>I<br>M           | COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI<br>COSPHI                                         |

| FORTRAM<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                                                  |                                      | ST     | ORAG | LOC  | SUBROUTIN<br>SUBR COD                                                                                    |                                                                                                  |
|-------------------|----------------|------|------------------------------------------------------------------------------|--------------------------------------|--------|------|------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| JIMBUL            | STRUL          |      | 5203111, 11011                                                               | <del></del>                          | 8000   |      | 100  | 208H COO                                                                                                 | C THE                                                                                            |
| COSRHO            | c σ s( ρ )     | ı    | See symbo!                                                                   |                                      | /STATE | 3/(  | 107) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUAS M<br>MODELA I<br>MODELB I<br>OUT I<br>PDBC I<br>PDY3A I      | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO |
| CS                | a              | 1    | Speed of sound                                                               | (FT/SEC)                             | /GENF  | R    | 310) | EQUA3 M                                                                                                  | CS<br>CS                                                                                         |
| D&                | D <sub>b</sub> | Ī    | Base drag                                                                    | (LBS)                                | / GENF | /(   | 537) | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>EQUAS I<br>FH3 I<br>OUT I<br>SDERS I<br>VT                | 08<br>08<br>08<br>08<br>08<br>08<br>08<br>08                                                     |
| DELTAE            | <sup>8</sup> Е | I    | Engine gi⇔bal deflection angle                                               | (RAD)                                | / GENF | /(   | 554) | BLGCON M<br>EL1 I<br>OUT I<br>REU3 D<br>VT I                                                             | DELTAE<br>DELTAE<br>DELTAE<br>DELTAE<br>DELTAE                                                   |
| DPDY              | ∂w/∂ <b>y</b>  | 1    | Matrix of partials of in-plane control state                                 | vector prt                           | /GENF  | π    | 610) | ACCEL I<br>BLGCON I<br>OUT I                                                                             | 0 P D Y<br>0 P D Y<br>0 P D Y                                                                    |
| DRAG              | D              | 1    | Aerodynamic drag                                                             | (LBS)                                | / GENF | /(   | 497} | ACCEL I<br>BL7 I<br>BL7 I<br>BL8 I<br>ENVPRM I<br>FH3 I<br>OUT I<br>PROPB O<br>PROPIN O<br>SOERS I<br>VT | DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG                                     |
| ECC               | e              | 1    | Orbital eccentricity                                                         |                                      | /ORBIT | /(   | 6}   | OUT I                                                                                                    | ECC<br>ECC                                                                                       |
| ENERGY            | E              | I    | Energy                                                                       |                                      | /ORBIT | /(   | 171  | OUT 1<br>PDBC 0                                                                                          | ENERGY<br>ENERGY                                                                                 |
| FTNM              |                | 1    | Feet to naut. ml. conversion, 1.645791                                       | 1629×10 <sup>-4</sup>                | /DATA  | /(   | 7)   | OUT I<br>PABS1 D<br>TRTOSZ I                                                                             | FTNM<br>FTNM<br>FTNM                                                                             |
| GAM               | 7              | ī    | Relative flight path angle                                                   | (RAD)                                | /STATE | 3/(  | 2)   | EQUA3 I<br>GUISA I<br>OUT I                                                                              | GAM<br>GAM<br>GAM                                                                                |
| GAMI              | Y <sub>I</sub> | I    | Inectial flight path angles                                                  | (RAD)                                | /ORBIT | 70   | 2)   | OUT I                                                                                                    | GAMI<br>GAMI                                                                                     |
| GM                | GM             | I    | Product of Newton's universal gravitation constant and the mass of the earth | (FT <sup>3</sup> /SEC <sup>2</sup> ) | /GLOBA | L/(  | 67)  | CRASH I<br>OUT I<br>PADS1 D<br>POBC I                                                                    | GM<br>GM<br>GM<br>GM                                                                             |

| FORTRAN          | MAIH           | CODE | DESCRIPTION                                                                       | STORA     |      | SUBROUTINE U                                                                                                                                            |                  |                                                      |
|------------------|----------------|------|-----------------------------------------------------------------------------------|-----------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------|
| SYMBOL           | SYMBOL         |      | DESCRIPTION                                                                       | HLUCK     | LOC  | SUBR                                                                                                                                                    | coo              | E VAR                                                |
| GR               | 9 <sub>r</sub> | 1    | Gravitational acceleration at surface of the earth. (FT/SEC <sup>2</sup> )        | /GLOBAL/{ | 1)   | ACCEL<br>8L5<br>EQUA3<br>FH3<br>GEINP<br>GEINP<br>GEINP<br>OUT<br>PADSI<br>PADSI<br>PADSI<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SI |                  | 68                                                   |
| HMNTM            | н              | I    | Mo mentum                                                                         | /DABIT /( | 181  | OUT<br>PDBC                                                                                                                                             | I<br>M           | MTMMH<br>MTMMH                                       |
| HT               | Q              | 1    | Heating                                                                           | /STATE3/( | 8)   | OUT                                                                                                                                                     | I                | HT                                                   |
| HTD              | Q              | i    | Heating derivative                                                                | /STATE3/( | 22)  | DER3A<br>OUT<br>PDBC<br>PDY3A                                                                                                                           | O<br>I<br>I      | HTD<br>HTD<br>HTD<br>HTD                             |
| 1 ATM            |                | 1    | Atmosphere option flag                                                            | /ARCDAT/( | 7)   | EQUAS<br>FXDAT<br>OUT<br>PDBC<br>VT                                                                                                                     | I<br>I<br>I<br>I | MTAI<br>MTAI<br>MTAI<br>MTAI<br>MTAI                 |
| IPFL61           |                | I    | IPFLG1#0 supresses print-out of velocity losses and inertial Euler angles.        | /GLOBAL/( | 69)  | FNTG<br>OUT<br>PDBC<br>PRINT<br>TRTOSZ                                                                                                                  | I<br>I<br>I      | IPFLG1<br>IPFLG1<br>IPFLG1<br>IPFLG1<br>IPFLG1       |
| IPFLG3           |                | I    | IPFLG3≠0 supresses print-out of impact data.                                      | /GLOBAL/( | 71)  | OUT<br>PRINT<br>TRTOSZ                                                                                                                                  | I<br>I<br>O      | IPFLG3<br>IPFLG3<br>IPFLG3                           |
| IPRINT           |                | M    | Print page counter initialization flag                                            | /xcodes/( | 168) | OUT<br>TEST<br>Topm                                                                                                                                     | M<br>I<br>O      | IPRINT<br>IPRINT<br>IPRINT                           |
| ITCT             |                | I    | Iteration counter                                                                 | /XCODES/( | 148) | BNTG<br>OUT<br>TEST<br>TOPM                                                                                                                             | I<br>I<br>M      | ITCT<br>ITCT<br>ITCT<br>ITCT                         |
| ITER             |                | 1    | Trajectory pass indicator.  ITER = 1, CONSTRAINTS = 2, OPTIMIZATION = 3, SOLUTION | /xcodes/( | 149) | AST3 FNTG GETIT MODELA OUT PAYO2 PROPIN TEST TOPM                                                                                                       | I<br>M           | ITER ITER ITER ITER ITER ITER ITER ITER              |
| JAER             |                | I    | Aerodynam:c model option flag                                                     | /ARCDAT/( | 9)   | BEROCO<br>EQUAS<br>GEINP<br>OUT<br>PROPB<br>PROPIA<br>VT                                                                                                | I<br>I<br>I      | JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER |
| JP3<br>30 OCT 72 | 6 01-46        | 1    | Option flag for third governing equation                                          | /xcobes/c | 219) | AGETB3 AST3 MODELA MODELA OUT PROPIN                                                                                                                    | M<br>M<br>I E    | JP3<br>JP3<br>JP3<br>JP3<br>JP3<br>JP3               |

| FORTRAN | HIAM           | CODE | DESCRIPTION                                                                                                          |       | STORAG    |      | <u>5 บ 3 ค อ บ</u>                                                                                                   | TINE                            | USAGE                                                        |
|---------|----------------|------|----------------------------------------------------------------------------------------------------------------------|-------|-----------|------|----------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------------------------------------|
| SYMBOL  | SYMBOL         |      | DESCRIT TON                                                                                                          |       | BLOCK     | LOC  | SUBR                                                                                                                 | CODE                            | VAR                                                          |
| L       |                | I    | Integration traffic control flag  L = 1 means evaluate derivatives  = 2 check cut-off  = 3 print or cut-off detected |       | /XCODES/( | 177) | BNTG<br>FNTG<br>DUT<br>RKTA3A<br>RKTB3A<br>SDINP                                                                     | I                               | L<br>L<br>L<br>L                                             |
| LIFT    | L              | I    | Aerodynamic ilft                                                                                                     | (LB5) | /GENF /(  | 496) | ACCEL<br>BL4<br>BL5<br>BL6<br>ENVPR#<br>FH3<br>OUT<br>PROPB<br>PROPIN                                                | 1<br>1<br>1<br>1<br>1<br>1<br>0 | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT |
| M       | n              | I    | Mass                                                                                                                 |       | /STATE3/( | 4)   | ACCEL<br>BL4<br>BL8<br>EQUA3<br>OUT<br>SDER3                                                                         | I<br>I<br>I<br>I                | 丹<br>丹<br>丹<br>丹<br>丹                                        |
| MACH    | М              | I    | Mach number                                                                                                          |       | /GENF /(  | 307) | BEROCO<br>ENVPRA<br>EQUAS<br>OUT                                                                                     |                                 | MACH<br>MACH<br>MACH<br>MACH                                 |
| am      | e<br>Ri        | I    | MASS derivative                                                                                                      |       | /STATE3/( | 18)  | DER3A<br>OUT                                                                                                         | 0<br>I                          | MD<br>MD                                                     |
| MU      | μ              | I    | Longitude                                                                                                            |       | /STATE3/( | 7)   | OUT<br>PDBC                                                                                                          | I<br>I                          | MU<br>MU                                                     |
| NCN     |                | Ĭ    | Number of elements in di                                                                                             |       | /XCODES/( | 160) | ADEQ3A<br>ADIC3A<br>ADIC3A<br>ADIC3A<br>ADIC3A<br>ADIC3A<br>BNTG<br>BSTD3<br>MTX3A<br>DUYO<br>TEST<br>TOPM<br>TRTOSZ | III                             | NCN<br>NCON<br>NCON<br>NCON<br>NCON<br>NCON<br>NCON<br>NCON  |
| NEO     |                | I    | Number of integrated states                                                                                          |       | /XCODES/( | 162) | ADICBA<br>ADICBA<br>ADICBA<br>AGETBA<br>AGETBA<br>AGETBA<br>BST03A<br>OUTUA<br>RSDENP<br>TOPM<br>TOPM<br>TREF3       | I                               | 00000000000000000000000000000000000000                       |
| P       | Pr             | I    | Semi-latus rectum                                                                                                    | (FI)  | /ORBIT /( | 5)   | OUT<br>POBC                                                                                                          | I                               | P<br>P                                                       |
| PA      | P <sub>a</sub> | I    | Atmospheric pressure                                                                                                 | (PSF) | /GENF /(  | 308) | EQUA3<br>FH2<br>IMPUL<br>OUT<br>PDBC<br>SDER3                                                                        | M<br>I<br>I<br>I<br>I           | BZM<br>PA<br>PA<br>PA<br>PA<br>PA                            |

| FORTRAN | MATH                 | COD | E DESCRIPTIO                                               | N              | SIURA     |      | SUBBOUTIN                                                                                                                             |                                                                    |
|---------|----------------------|-----|------------------------------------------------------------|----------------|-----------|------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| SYMBOL  | SYMBOL               |     | DESCRIPTIO                                                 | IV             | BLUCK     | LDC  | SUBR COO                                                                                                                              | E VAR                                                              |
| PERGEE  | R                    | 1   | Perigee radius                                             | (FT)           | /ORBIT /( | 12)  | OUT I                                                                                                                                 | PERGEE<br>PERGEE                                                   |
| PHI     | •                    | I   | Bank angle                                                 | (RAD)          | /AEC03 /( | 11)  | GUI3A M<br>MODELA M<br>MODELB M<br>DUT 1                                                                                              | PHIR<br>PHI<br>PHI<br>PHI                                          |
| PHIB    | φ                    | I   | Bank angle                                                 | ( DEG )        | /AEC03 /( | 10)  | AGETB3 O<br>AST3 M<br>GUI3A M<br>MODELA M<br>MODELB I<br>MIX3A O<br>OUT I                                                             | PHID<br>PHID<br>PHID<br>PHID<br>PHID<br>PHID<br>PHID               |
| PI      | π                    | 1   | Constant 3.141592653                                       |                | /DATA /(  | 1)   | DUT I<br>PADS1 D                                                                                                                      | PI<br>PI                                                           |
| PSI     | <b>V</b>             | I   | Azīmuth                                                    |                | /STATE3/( | 5)   | EQUA3 I<br>GUI3A I                                                                                                                    | PSI<br>PSI<br>PSI                                                  |
| PSII    | $\Psi_{_{ m I}}$     | I   | Inertial azlauth                                           | (RAD)          | /ORBIT /( | 3)   | OUT 1<br>POBC M                                                                                                                       | PSII<br>PSII                                                       |
| P1      |                      | I   | First element in in-plane control in Corresponds to thrust | rector.        | /GENF /(  | 569) | BLGCON M<br>BLGCON M<br>OUT I                                                                                                         | P<br>P1<br>P1                                                      |
| Q       | q                    | I   | Dynamic pressure                                           | (PSF)          | /GENF /(  | 303) | ENVPRM I<br>EQUAS M<br>OUT I<br>PDBC I<br>VT I                                                                                        | 0<br>0<br>0                                                        |
| RAD     |                      | 1   | Radîan to angle conversion, 57.2957                        | 7951           | /DATA /{  | 2)   | BEROCO I<br>BLGCON I<br>ENVPRM I<br>EQUAS I<br>FNTG I<br>GUISA I<br>MODELA I<br>MOTELA I<br>PAOSI I<br>PAOSI D<br>SDINP I<br>TRIOSZ I | DEG<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD |
| RE      | Rey                  | Ŋ   | Unit reynolds number                                       | (1/FT)         | /GENF /(  | 306) |                                                                                                                                       | RE<br>RE                                                           |
| RHO     | ρ                    | I   | Latitude                                                   |                | /STATE3/( | 6)   | EQUA3 I<br>OUT I                                                                                                                      | AHO<br>RHO                                                         |
| RO      | ρ <sub>a</sub>       | I   | Atmospheric density                                        | (\$LUGS/FT**3) | /GENF /(  | 309) | BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 I<br>OUT I<br>PDBC I<br>PDY3A I                                                                    | RO<br>RO<br>RO<br>RO<br>RO<br>RO                                   |
| SCROSS  | s <sub>c</sub>       | i   | Cross range                                                | (FT)           | /ORBIT /( | 149) | OUT I                                                                                                                                 | SCROSS<br>SCROSS                                                   |
| SDOWN   | S <sub>D</sub>       | I   | Down range                                                 | (FT)           | /ORBIT /( | 148) | OUT I<br>PDBC O                                                                                                                       | SDOWN<br>SDOWN                                                     |
| \$10    | sin(& <sub>E</sub> ) | I   | See symbol                                                 |                | /GENF /(  | 555) | EL2 I<br>OUT I<br>VT M                                                                                                                | SID<br>SID<br>SID                                                  |

| FUHTHAN<br>SYMBOL | MATH<br>Symbol | CODE            | DESCRIPTION |       | 8191K   | RAGE | LOC  | <u> </u>                                                                                                             | T I NI<br>CODI                          | USAGE<br>VAR                                                                                               |
|-------------------|----------------|-----------------|-------------|-------|---------|------|------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------|
| SINA              | sìn∝           | I See symbol    |             |       | /AECO3  | R    | 7)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>GUI3A<br>OUT                                                             | I<br>I<br>I<br>I<br>M<br>I<br>M         | SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA                                               |
| SINPHI            | នាំព∲          | I See symbol    |             |       | /AECO3  | /(   | 12)  | ACCEL<br>BL4<br>MODELA<br>MODELB<br>OUT                                                                              |                                         | SINPHI<br>SINPHI<br>SINPHI<br>SINPHI<br>SINPHI                                                             |
| 5 1 NR HO         | <b>sιπ(ρ</b> ) | 1 See symbol    |             |       | /STATE3 | 370  | 706) | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>OUT<br>PDBC<br>PDY3A                                      |                                         | SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO<br>SINRHO |
| SMIMAJ            | a <sub>s</sub> | I Semi-major as | cis.        | (FT)  | /ORBIT  | /(   | 10)  | OUT<br>PDBC                                                                                                          | I<br>M                                  | SMIMAJ<br>Smimaj                                                                                           |
| SORT              |                | F Square root 1 | function    |       | /SQRT   | /(\$ | ,    | ANLATM CRASH DCRASA DERSAA HUNT LA MODELLB OUT 63 PAYO2 PDYSA STORE WTSCH                                            | *********                               | SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT                                               |
| STOT              | S <sub>T</sub> | I Total range   |             | (FT)  | /ORBIT  | /(   | 158) | OUT<br>PDBC<br>TRTOSZ                                                                                                | I<br>O<br>I                             | STOT<br>STOT<br>STOT                                                                                       |
| T                 | T              | I Thrust        |             | (LBS) | / GENF  | /(   | 411) | ACCEL<br>BLGCON<br>BL4<br>BL4<br>BL5<br>BL8<br>EL2 A3<br>FH1<br>FH2<br>FH3<br>FH4<br>UDUT<br>PROPIN<br>REU3<br>SDER3 | 1 M 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1                |

| FORTRAN | MATH           | CODE            | DESCRIPTION |          | STORA     | 3E   | SUBHOUTINE US                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ΔĢE               |
|---------|----------------|-----------------|-------------|----------|-----------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| SYMBOL  | SYMBOL         |                 | DESCUTLITON |          | BLULK     | LUC  | SUBR CODE V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | AR                |
| TIME    | t              | î Tîme (élapse  | d )         |          | /GENF /(  | 493) | ADICBS O TIME ASTS I TIME BNTG M TIME CONS I TIME CONS I TIME DTFS I TIME ENUPRM I TIME ENUAS I TIME FNTG M TIME MODELA I TIME MODELA I TIME PROPIN I TIME PROPIN I TIME REUS M TIME RKTBSA M TIME RKTBSA M TIME YREFS M TIME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | папапапапапапапа  |
| TIMEPH  | τ <sub>p</sub> | I Phase time    |             | (SEC)    | /GENF /(  | 318) | EBUA3 O TIM<br>FNTG M TIM<br>GETIT I TIM<br>GUI3A I TIM<br>DUT I TIM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | EPH<br>EPH<br>EPH |
| TIMES   | 7              | I Arc time      |             | (SEC)    | /GENF /(  | 3191 | AST3 I TIME EQUAS O TIME FATE M TIME GETIT I TIME OUT I TIME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ES<br>ES<br>ES    |
| V       | •              | I Relative veli | ocity       | (FT/SEC) | /STATE3/( | 1)   | ACCEL I VAR ADJUST M VAR AGETB3 O VAR AST3 I VAR BL4 I V VAR BL5 I VAR DEF3 I VAR EQUAS I VAR EQUAS I VAR MODELA I VAR MODELA I VAR MODELA I VAR MODELA I VAR PDBC I VAR PDBC I VAR PDBC I VAR PDBC I VAR RKTASA M VA |                   |

| ORIRAN<br>SYMBOL | MATH<br>SYMBOL       | CODE | DESCRIPTION DESCRIPTION                                                                  | ) N                 | S T C<br>B L D C K | ) R A G | LOC  | SUBROU<br>SUBR                                                                                                                                  | CODE                                    | USAG<br>VAR                                                  |
|------------------|----------------------|------|------------------------------------------------------------------------------------------|---------------------|--------------------|---------|------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|--------------------------------------------------------------|
| VAR              | V                    | Í    | Relative velocity                                                                        | (FT/SEC)            | /STATE:            | 33/(    | 1)   | ADDITS ADDITS CCCUSTS ADDITS ADDITS ADDITS BLANSSA MASALLA BLANSSANSALLA BLANSSANSALLA BLANSSANSALLA BLANSSANSANSANSANSANSANSANSANSANSANSANSANS |                                         | VVAR<br>VVAR<br>VVAR<br>VVAR<br>VVAR<br>VVAR<br>VVAR<br>VVAR |
| VI               | v <sub>I</sub>       | I    | Inertial velocity                                                                        | (FT/SEC)            | /ORBIT             | /(      | 1)   | OUT<br>PDBC<br>PDBC                                                                                                                             | I                                       | VI<br>ORBPR                                                  |
| UNU              | $\mu_{\mathbf{a}}$   | 1    | Atmospheric viscosity Edynamic]                                                          | (SLUGS/FT/SEC)      | /GENF              | /(      | 311) | OUT<br>Pobc                                                                                                                                     | I                                       | VNU<br>UNV                                                   |
| ы                | Ш                    | I    | Weight                                                                                   | (LBS)               | /GENF              | /(      | 412) | BL5<br>ENVPRM<br>EQUA3<br>FH3<br>OUT<br>PDBC<br>REU3<br>TRTOSZ                                                                                  | I<br>M<br>I<br>I<br>I<br>I              | 년<br>년<br>년<br>년<br>년                                        |
| וא               | J                    | 1    | Control blend factor                                                                     |                     | /GENF              | /(      | 560) |                                                                                                                                                 | 1                                       | XJ<br>XJ<br>XJ                                               |
| хкз              |                      | I    | Third control vector governing equi<br>Corresponds to error in algebraic<br>involving a. |                     | /GENF              | /(      | 574) |                                                                                                                                                 | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>0    | XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3<br>XK3                |
| ΧĹ               | $\gamma_{f k^1 U}$ 1 | I    | Matrix of adjoint variables                                                              |                     | /STATE:            | 3/(     | 246) | ADEQ3A<br>ADIC3A<br>ADIC3A<br>ADIO3A<br>AST3<br>BGET3<br>BST03<br>MTX3A<br>OUT<br>STAU<br>STVRL3<br>TRAN3                                       | # M M M M M M M M M M M M M M M M M M M |                                                              |
| XMCG             | M <sub>CG</sub>      | 1    | Aerodynamic mement about center of                                                       | gravity<br>(FI-LBS) | / GENF             | /(      | 5441 |                                                                                                                                                 | I<br>I                                  | XMCG<br>XMCG<br>XMCG                                         |
| XMUI             | $\mu_{_{ m I}}$      | 1    | Inertial longitude                                                                       | (RAD)               | /ORBIT             | 11      | 41   | OUT                                                                                                                                             | I                                       | IUMX                                                         |

| ORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION     | <u>STORASE</u><br>Bluck l | UL SUBROUTINE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <u>USAGE</u><br>Vah                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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| UNO6             | 3111800        |      | all output data | /.UN06./(\$               | BLICO D BNORYC D CRASH D FRENCH D FRENC | UNO6. |

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*R , R
*VNU , P
*SYSQ , T
*TIST(20), T
*TIMPR , L
*AE , F
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  GENF
  GENF
GENF
GENF
GENF
GENF
FRAT
  MACH,
  MÁCHR,
   SENF
  (14) VARL (99) BVARL(99)
0,9),05 (20,9),CDSGAM
1,SINRHO ,CDSRHO
,OMEGA2
,RDV ,MDV
,GDG ,RDG
,GDR ,RDR
,GDR ,RDR
,GDR ,RDR
,GDR ,RDR
  STATE3D
STATE3D
STATE3D
  ,SVY(10)
,SAYBP(15)
,OCORO2
  ,YO(9)
,SINGAM
,OCORHO
   STATE 3D
  STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
   PDV
PDG
PDR
PDM
VDO
  ,00V
,00G
,00R
,V0P
,600
  STATE3D
STATE3D
STATE3D
   E0043
E0043
E0043
   44555555555555666234566767771345
   FAUV3
   EQUV3
AECO3
   ALPHA
PHIO
PHIO
PEX
CMAM CAM
CLA
ARGP,
CAPX
OVIDG,
DVIDG,
DVIDG,
DVIDBA
DPIDH
DMIDS
DPOP
  ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
   ,PDA
,SINPHI
,CDO
,CLOM
,FKM
  AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
AECO3
ORBIT
  *APHO
*SIMA
*COSPHI
*CDOM
*CM
   , VDA
, PHID
, XLAMA(9)
, XCGM
, CHG
, CLM
  +CLAM
+CD
   PSII,
ASCNOD,
CAPY,
   XMUZ
   COMMON/ OF ECC.
PERSEE,
HMNTH,
BYIGH,
DPIDY
DPIDY
DPIDY
DMIDRO,
DPOPS
DECOM
  APOGEE
   SMIMAJ,
ASYMP,
  ENERGY,
   ORBIT
ORBIT
ORBIT
   DGIDY,
DGIDMU,
DGIDMU,
OMIDPS,
OPDM,
DECDM,
OIDG,
DBEOV
   DVIDRO,
DGIDPS,
DPIDM,
DMIDH,
  DVIDMU,
OGIDRO,
DPIDPS,
DMIDM
   ORBIT
   ORBIT
ORBIT
ORBIT
  DAIDAU,
DPORD
DECOPS,
DIDA
DBEOH
DNOOS
OSADV,
   DPDV
   DPDG
DECDV,
DECDMU,
DIORO
DBEDPS,
   DPDG
   DPDH
  DECOG ,
DIDV
   ORBIT
ORBIT
ORBIT
ORBIT
   DPDMU ,
DECDRO,
  DIDPS ,
   DIOH
DBEDG
ONDDV
DNODMU,
   DBEDRÓ,
  ้อธิยังคม.
   DNODH
DSADG
   DNODPS
DSADA,
  DNODRO
OSMOPS
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CCMMON/ORBIT/

* OSMORO, OSMOMU, DAPDV, OAPDG, OAPDH, D.

* OAPOPS, DAPORO, DAPONU, DEEDV, OPEDG, O

*DPEDM, DEDPS, OPEDGO, DPEDMU, DANDY, DANDRU, DANDRU, DANDRU, DANDRU, DANDRU, DANDRU, DANDRU, DANDRU, DOXDRS, DCXORSO, D

* OCVDV, DCYOG, DCYOH, DCYOM, DCYOPS, OCXORSO, D

* OCVDV, DCYOG, DCYOH, DCYOM, DCYOPS, OCXORSO, D

* OCVDV, DCYOG, DCYOH, DCYOM, DCYOPS, OCXORSO, D

* DCYDRU, OASDV, DASDG, DASDH, DASDM, D

* DEADDRS, DENDRO, DENDRU, DROBG, DENDRH, D

**DENDPS, DENDRO, DENDRU, DROBY, DROBG, D

**DENDPS, DENDRO, DENDRU, DROBY, DROBG, D

**DIMENSION ORBPRM(18), PPO(1,18)

**EQUIVALENCE (VI, ORBPRM), COVIDV, PPO)

**COMMON/ORBIT/ YMXXFF, SXXLMR, CSXLMR, SOONN, SCROSS, TD, TC

**SNPSR, CSPSR, SXXLMR, CSXLMR, SOONN, SCROSS, TD, TC

**SNPSR, CSPSR, SXXLMR, CSXLMR, SOONN, SCROSS, TD, TC

**SNPSR, CSPSR, SXXLMR, CSXLMR, SNGNU, CSAND

**STOT (CSI, SNI, SNGNU, CSAND

**STOT (CSI, SNI, SNGNU, CSAND

**STOT (CSI, SNI, SNGNU, CSAND

**GR.

**GR.

**GR.

**CARRET , YMURF
   ORBIT
ORBIT
ORBIT
ORBIT
ORBIT
ORBIT
        76.
77
78
79.
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83.
845.
   DAPOM,
DEEDH,
DANDS
DCXDWU,
DCXDWU,
DCYDRO,
   DASOPS,
DENDM
DAODH
  ORBIT
ORBIT
ORBIT
ORBIT
        867889.
91.
923.
95.
97.
97.
98.
   ORBIT
ORBIT
ORBIT
ORBIT
ORBIT
ORBIT
ORBIT
OCBAL
  ,CPSII
  , YAURF
  ,LUM
,IB(4)
   GLOBAL
   GLOBBALL
GLOBBAL
GLOBBAL
GLOBBAL
GLOBBAL
GLOBBA
GLO
  NEARC
  IPFLG2, IPFLG3, IPFLG4, INEQFL(20)
     100
101
102
103
104.
  ,UMF
,JOP3
  ,TMPF
,JDP4
   JGID(20,2), JPH (20,2), NSAB NICNB IFB IND IARC ISTART JPS JS NAD NCASE NFH N ISTNB ISTPP L NPHP NPHB N(20), JP1, JP2, JP3
     106.
108.
109.
110.
111.
112.
113.
114.
115.
116.
   XCODES
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
   XISP
JAER
, GMDOT
, MAED
, MXCG
, ZCGR
   DTNC
GMAX
PHMAX
MAEF
MMDA
ZE
REMAX
  TMULT
JPRO
ALFMAX
MAEE
MZCG
XE
   ,OTPI
  GMAX
MAEA
MAEG
MWDB
  118.
119.
120.
121
122
123.
124.
  RHOB
  OAULT
   ARCHAT
  OUT3B
PO14
    126.
   1 CONTINUE
SAMD= SAM+RAD
PSIDS=PSI*RAD
AP(1)= TIME
AP(2)= ALT
  127.
128.
   P6114
   10
10
0 0 13 B
  129
130.
131.
132.
  AP(2)= ALT
AP(3)= V
AP(4)=GAMD
AP(5)=PSIDG
AP(6)= MU*RAD
AP(7)= RHD*RAD
AP(8)= TIMES
AP(9)= W
HD=0
   DUTSB
   OUT38
APR
APR
    133.
134
135.
   00T3B
00T3B
00T3B
00T3B
  136.
137
138
139
   0413B
0413B
  MD=0

CALL PDBC(-1,FF,FF,FF,0,M0 )

AP(10) = V1

AP(11) = GAMI*RAD

AP(12) = PSII*RAD

AP(13) = XMUI*RAD

AP(13) = XMUI*RAD

AP(14) = SCROSS*FTNM

AP(15) = IIAEPH

AP(16) = M

AP(17) = VAR(NEQ+1)

AP(18) = MT

AP(19) = MTD
      140.
141
142.
   QUT3B
   DUT3B
     143.
144.
145.
146.
   OUT3B
OUT3B
   P014
   DUT3B
   OUT3B
SIZ
OUT3B
```

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```
AP(20) = STOT *FTNM

AP(21) = SOOMM*FTNM

RE=0.

IF I ATM. HE.2) RE=V*RO/VMU

AP(22) = RE

AP(23) = PA

AP(24) = RO

AP(25) = CS

AP(26) = MACM

AP(45) = JP3

AP(46) = XK3

AP(30) = PHID

SACHI = SINA*COSPHI

IF(ABS(SACHI).GT.1.) SACHI=SIGN(1.,SACHI)

SASHI=SINA*SIMPHI

IF(ABS(SASHI).GT.1.) SASHI=SIGN(1.,SASHI)

AP(32) = GAMD + ASIM(SASHI)*RAD

AP(31) = JSIDG + ASIM(SASHI)*RAD

AP(31) = IJ

AP(32) = Q

AP(33) = XACG

AP(35) = DRAG

AP(35) = DRAG

AP(36) = T

IF(MD.ED.O.) GO TO 10

AP(43) = O.
  PO14
PO14
FINI
FINI
OUT38
 0UT38
0UT38
  DUT 38
   APR
APR
APR
OUT3B
   OUT3B
OUT3B
PO14
PO14
PO14
PO14
PO14
OUT3B
   00138
00138
00138
  OUT 3B
  OUT3B
   10
  OUT3B
  20-7
   0.0138
 179
  10 AP( 43 )=0.
  OUT3B
   20 CONTINUE
AP(48)= DELTAE *RAD
IF(JAER-2) 30,30,40
 180.
181.
182.
  DUT 3B
  DUT 3B
  OUT3B
   183.
184.
185.
   30 AP(49)= (T + LIFT+SIMA-DB - DRAG+COSA) / W
AP(50)= ( LIFT+COSA+ DRAG+SIMA)/ W
  OUT38
  auT38
  S0 T0 50
  DUT3B
   50-
  186.
  46 AP(49)= (T=COD +LIFT=SINA-DB -DRAS=COSA) / W
AP(50)=(LIFT=COSA+DRAS=SINA-T+SID)/W
   OUT3B
  40 AP(49)= (T*COD *LIFT*SINA-DB -DFR
AP(50)=(LIFT*COSA*DRAG*SINA-T*SID

50 AP(51)=SQRTIAP(49)**2*AP(50)**2)
AP(27)= CL
AP(28)= CD
AP(37)= XL(1,NCM)
AP(38)= XL(5,NCM)
AP(38)= XL(5,NCM)
AP(40)= XL(3,NCM)
AP(40)= XL(3,NCM)
AP(41)= XL(6,NCM)
AP(41)= XL(6,NCM)
AP(42)= XL(7,NCM)
CALL COROSÍCOSSHO,SINRHO)
IF(IFFLS1.NE.G) SO TO 60
AP(62)= SARINAJ *FTEM
AP(63)=ECC
AP(64)=AINCL * RAD
AP(63)=ECC
AP(64)=AINCL * RAD
AP(65)= ASCNOD* RAD
AP(66)= ASCNOD* RAD
AP(66)= ARGP* * RAD
AP(66)= APOSEE * FTEM
AP(66)= APOSEE * FTEM
AP(68)= APOSEE * FTEM
AP(71)=HERGY
AP(72)=HMITA APOSEE
AP(73)= P*FTEM
AP(73)= P*FTEM
AP(73)= P*FTEM
AP(73)= AP(71)=HMITA AP(73)= P*FTEM
AP(73)= AP(71)=HMITA AP(73)= AP(71)=AP(73)=AP(71)=AP(73)=
   P014
   P014
P014
P014
AAA
AAA
AAA
 188.
  189.
190.
191.
192.
194.
195.
196.
197.
   AAA
AAA
PO14
PO14
OUT3B
   60-
260.
201.
262.
  P014
0UT3B
   OUT3B
OUT3B
203-
204-
205-
206-
207-
208-
209-
210-
211-
212-
213-
  DUT38
   P014
P014
OUT38
OUT38
   SMIMAI/EM)
   OUT38
OUT38
  P014
  อยี 38
  OUT 3B
214.
215.
216.
217.
218.
   60 CONTINUE
IF(IPFLGS. NE. 0) GO TO 70
IF(ITER.NE.3) GO TO 96
IF(V.LT.3GO..OR.ABS(COSSAM).LT..GG1) GO TO 70
CALL CRASH
   0UT3B
0UT3B
   76-
   PO14
FINI
OUT3B
  96
  76-
   76 CONTINUE
IF(ITER.LT.3) SO TO 90
IF(IPFLG1.NE.O) SO TO 90
AP(55)=VAR(NEQ+2)
219.
220.
221.
222.
   OUT3B
PO14
OUT3B
  SIZ
```

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```
223
224
225
226.
228.
229.
230.
231
232.
232.
234.
235.
   AP(56)=VAR(NEQ+4)
AP(57)= VAR(NEQ+5)
AP(58)= VAR(NEQ+3)
  51 Z
51 Z
51 Z
                                 AP(58)= VAR(NEQ+3)

90 CONTINUE
CALL PRINT(ITCT,1TER/3,0,1PRINT)
IPRINT =0
RETURN
ENTRY OUTERR
HRITE (6,100)

100 FORMAT (49H **** CONTROL DIVERGANCE (SEE NEXT PRINT BLOCK) )
CALL POUMP(APHO,PHI,1,L,JP3,2,P1,DPDY(3,7),1)
GÜ TO 1
END
   08138
08138
P014
08138
P014
P014
P014
P014
P014
P014
P014
```

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# SUBRØUT I NE PAT63

#### Subroutine PAT63

## Purpose

Subroutine PAT63 computes atmosphere properties and derivatives for the 1963 Patrick Air Force Base atmosphere model.

### Description

The reference for this atmosphere model is noted in Vol I, Section 3.3.2. This model has some programming limitation that should be noted. Above about 360,000 feet, the mathematical representation is very poor; therefore, the properties are automatically fixed at that point and partials are set to zero. Below sea level, a similar procedure is employed in the subroutine.

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                             | <u>510</u><br>810CK | RAGE | .0 C | <u>SUBROU</u><br>SUBR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |                                                              |
|-------------------|----------------|------|---------------------------------------------------------|---------------------|------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------------|
| sc                |                | I    | Constant in Sutherlands equation, 198                   | /DATA               | 70   | 4 )  | PADS1<br>PAT63                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | D<br>1 | SC<br>SC                                                     |
| SORT              |                | F    | Square root function                                    | /SQRT               | /(\$ | ,    | ANLATM CRATOSA DERIOSA ENVPR MODELL PATOSE PATOS | ****** | SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT |
| TF                |                | ī    | Constant in Sutherlands equation, 392                   | /DATA               | 70   | 6)   | PADS1<br>PAT63                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | D<br>I | TMPF<br>TF                                                   |
| UMUF              |                | ī    | Constant in Sutherlands equation, .301x10 <sup>-6</sup> | /DATA               | /(   | 5)   | PADS1<br>Pat63                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | D<br>I | UMF<br>UMUF                                                  |

PATES

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PAT63I
PAT63I
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PAT63I
PAT63I
PAT63I
PAT63I
   1.
2.
3.
4.
5.
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8.
10.
   PAT631
   PAT631
PAT631
PAT631
PAT631
PAT631
PAT631
PAT631
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   PAT63I
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36.
37.
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 44.
45
46.
47.
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PAT631
89901234567890123456789012345
   PAT63I
PAT63I
PAT63I
PAT63I
  PAT631
PAT631
PAT631
APR27
  PAT63I
PAT63I
PAT63I
   DATA
DATA
DATA
PAT63I
   COMMON/DATA/
PTI RAD RDI SC ,UMF ,TMPF
FTNM CAR JOP1 JOP2 JOP3 ,JOP4
H=0
IF(H.LT.O.) H=O.
IF(H ST 370000.) H=370000.
X= (H- 2 E5)*1.E-5
PXRHO = RO + X*(R1+ X*(R2 +X*(R3 +X*(R4 +X*(R5 +X*(R6 +X*(R7 +X*(R7 +X*(R1 +X*(R12 +X*(R13))))))))))
PXF = SO + X*(S1+X *(S2 +X*(S3 +X*(S4 +X*(S5 +X*(S7 +X*(S7 +X*(S1 
   PAT631
JULY28
PAT631
PAT631
PAT631
```

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```
FV(2)= RHO+EXP(-PXRHD)
PV(3)= A0 *EXP( PXA)
TM = PV(3)*2 * COMST1
FT = (IM/IF)* SQRT(IM/IF)
TSC = IM * SC
UMU = COEF1 * FT/TSC
PV(4)=UMU
IF(0 GT 370000.) SO TO 30
IF(MGG E0 1.AND.JP3.LT 7) RETURN
DXRHD = U0 *X*(U1)*X*(U2*X*(U3*X*(U4*X*(U5*X*(U6 *X*(U1 *X*(U8*1 X*(U9 *X*(U1) *X*(U1) X*))))))))
DXP = Y0 * X*(U10 *X*(U1)*X*(U3*X*(V4*X*(V5*X*(V6 *X*(V7 *X*(V8*1 X*(V9 *X*(V10 *X*(V1) X*(V1) X*(V1
   PAT63I
PAT63I
PAT63I
PAT63I
PAT63I
PAT63I
                  PAT631
JULY28
PAT631
PAT631
  30
   PAT631
PAT631
PAT631
PAT631
   PAT63I
PAT63I
PAT63I
PAT63I
   PAT631
PAT631
PAT631
PAT631
PAT631
PAT631
PAT631
PAT631
PH15Z
PH15Z
                 101
102
5 CONTINUE

IF(MGO.EQ 1) RETURN

IF(JP3 LT 7) RETURN

IF(JP3-8) 20,20,10
                 103
104.
105
106
   PHISZ
   PAT631
PAT631
  10-20
   THE SPS = 20,20,10

10 CONTINUE

0XA = Z0 + X*(Z1 + X*(Z2 + X*(Z3 + X*(Z4 + X*(Z5 + X*(Z6 + X*(Z7 * + X*(Z8 + X*(Z9 + X*(Z10 + X*Z11))))))))

ARR = 1 E-10=PV(3)*(QXA +DXA*DXA)

TM2 = CONST2*(PV(3)*ARR + PV(7)*PV(7))

TM20= TN*TM

GT2 = 2 * GT/ TSC/TSC

FT2 = 0 75* FT/TM20

UMU2 = UMUF*((FT*GT1 + GT*FT1)* TM2 + (FT*GT2 + 2 *FT1*GT1 + GT*FT2)* TM1* TM1)
               107
108
109
110.
111
112
113
114
115
   PAT631
   PAT63I
PAT63I
PAT63I
PAT63I
   PAT631
PAT631
PAT631
   20 CONTINUE PAT631

0XRHO = X0 + X*(X1 + X*(X2 + X*(X3 + X*(X4 + X*(X5 + X*(X6 + X*(X7 PAT631

* + X*(X8 + X*(X9 + X*(X10 + X*X11)))))))) PAT631

RORR = -1 E-10*PV(2)*(QXRHO -DXRHO*DXRHO) PAT631

RETURN PAT631
               117.
118
119
120
121
   PAT63I
PAT63I
PAT63I
   JULY28
JULY28
JULY28
JULY28
JULY28
                 122
123
124
125.
126
127
   30 DO 40 1=5,8
40 PV(1)=0.
UMU2=0.
RORR=0.
   END
   PAT631
```

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# SUBRØUT I NE PAYØ2

## Purpose

PAY02 computes the payoff improvement.

## Description

The method of computing the payoff improvement is described in Sections 12.2 and 15.3 of Volume I.

| FORTRAN | HTAM                | CODE | DESCRIPTION                                                                                                             | 5 11    | ) F A G |      | SUBROL                                                                         |                  |                                                              |
|---------|---------------------|------|-------------------------------------------------------------------------------------------------------------------------|---------|---------|------|--------------------------------------------------------------------------------|------------------|--------------------------------------------------------------|
| SYMBOL  | SYMBOL              |      | DESCRIPTION                                                                                                             | BLOCK   |         | LOC  | SUBA                                                                           | CODE             | VAR                                                          |
| •       | A                   | 1 .  | Control integral metrix                                                                                                 | /GENF   | 16      | 109) | ADEQ3A<br>ADICB3<br>BGET3<br>BNTS<br>BST03<br>MTX3A<br>PAY02<br>SDIMP<br>TRAM3 |                  | A A A A A A A A A A A A                                      |
| В       | В                   | н    | B matrix                                                                                                                | /PAY02  | /(+     | 3    | PAY02                                                                          | ¥                | ₿                                                            |
| DC      | 44                  | ы    | Predicted pay-off suprovement                                                                                           | /PAY02  | /(+     | )    | PAY02                                                                          | ы                | DC                                                           |
| DCON    | ď¥́į                | M    | Asked for correction in constraint misses and payoff voctor                                                             | /GENF   | 11      | 289) | CON3<br>MTX3A<br>PAYO2<br>TEST<br>TOPM<br>TRTOS2                               | 0<br>M<br>M<br>1 | DCON<br>DCON<br>DCON<br>DCON<br>DCON<br>DCON                 |
| DPAY    | φφ                  | I    | Initial payoff laprovement                                                                                              | /STS    | 70      | 1)   | PAYO2<br>SDINP<br>SDINP<br>SDINP<br>TEST<br>TOPM                               | 1 0 1 1 0        | DPAY<br>DPAY<br>IST<br>ST<br>DPAY<br>IDPAY                   |
| IPS@    | ( dP ) <sup>2</sup> | Ħ    | Metric of control and parameter changes [sd]                                                                            | /GENF   | /(      | 302) | PAYO2<br>TEST<br>TRTOSZ                                                        |                  | DPSQ<br>PSISQ<br>DPSQ                                        |
| 350     |                     | W    | Terminal constraint elements                                                                                            | /PAY02  | /{ *    | ,    | PAY02                                                                          | ¥                | 950                                                          |
| IPASS   |                     | I    | Sizing Iteration counter                                                                                                | /SIZIN  | G/(     | 2911 | GEINP<br>PADS1<br>PAY02<br>SIZE<br>SIZIN<br>SSSP                               | M<br>1<br>M<br>1 | IPASS<br>IPASS<br>IPASS<br>IPASS<br>IPASS<br>IPASS           |
| ITER    |                     | M    | Irajectory pass indicator.  JTER = 1, CONSTRAINTS  = 2, OPTIMIZATION  = 3, SOLUTION                                     | /xcooes | 5/0     | 149) | AST3<br>FNTG<br>GETIT<br>MODELA<br>OUT<br>PAYO2<br>PROPIN<br>TEST<br>TOPM      | I<br>I<br>I      | ITER<br>ITER<br>ITER<br>ITER<br>ITER<br>ITER<br>ITER<br>ITER |
| I 20P   |                     | M    | First optimization pass flag sets de = OPAY. Also used to indicate payoff degradation due to restoration of constraints | /xcodes | 5/(     | 136) | PAYO2<br>TEST<br>TOPM                                                          | M<br>M<br>O      | 120P<br>120P<br>120P                                         |
| 13      |                     | ш    | Pointer array indicates zeros on A matrix diagonal                                                                      | /PAY02  | /(+     |      | PAY02                                                                          | ¥                | jj                                                           |
| jĸ      |                     | M    | Integration routine flag tells which derivative evaluation in Runge-Kutta cycle                                         | /XCODES | 576     | 151) | ADICSA<br>BNTS<br>MODELA<br>PAYO2<br>RKTASA<br>RKTBSA                          | I                | ]K<br>]K<br>]K                                               |
| NCC     |                     | H    | Number of elements in $d\Psi$ at terminus excluding payoff.                                                             | /PAY02  | /(*     | )    | PAY02                                                                          | ¥                | NEC                                                          |

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| FORTRAN | MATH             | CODE DESCRIPTION                                                                     | STORAGE        | SUBROUTINE USAG                                                                                                                                                                                                                                         |
|---------|------------------|--------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL           | CORE DESCRIENTOM                                                                     | BLOCK LOC      | SUBA CODE VAR                                                                                                                                                                                                                                           |
| NCN     |                  | M Number of elements in d€                                                           | /XCODES/( 160  | ADEDJA I NCN<br>ADICBA I NCN<br>ADICBA I NCN<br>ADICBA I NCN<br>ADJUSTI ACN<br>ASTJ M NCN<br>BNTG I NCN<br>BNTG I NCN<br>MTXJA I NCN<br>OUT I NCN<br>PAYOZ M NCN<br>TEST M NCN<br>TEST M NCN<br>TEST M NCN<br>TRAMB I NCN<br>TRAMB I NCN<br>TRAMB I NCN |
| NCHST   | n                | I Number of problem constraints                                                      | /XCOBES/( 132) | BGET3 I NCNST BST03 I NCNST CON3 I NCNST PAYD2 I MCNST SDIMP M NCNST SUMS I NCNST TEST I NCNST TOPM I NCNST TRANS I NENST                                                                                                                               |
| NO      |                  | W Number of non-zero A diagonal elements                                             | /PAY02 /(*     | PAYD2 M ND                                                                                                                                                                                                                                              |
| NP AR A |                  | I Number of adjustable parameters in trajectory problem.                             | /PARAM /( 13)  | ADJUST I NPARA BNTS I NPARA FNTS I NPARA MTX3A I NPARA PAY02 I NPARA SDIMP M NPARA STAU I NPARA TEST I NPARA                                                                           |
| PMIN    |                  | I Minimum payoff improvement                                                         | /STS /( 2)     | PAYDZ I PMIN<br>SDINP I PMIN<br>TEST I PMIN                                                                                                                                                                                                             |
| RAT     |                  | W Ratlo of current last pay-off improvement                                          | /PAY02 /(# )   | PAYOZ W RAT                                                                                                                                                                                                                                             |
| SIG     |                  | i Payoff sign.<br>SIG < 0 Payoff to be minimized,<br>SIG > 0 Payoff to be maximized. | /GLOBAL/( 65)  | PAYO2 I SIG<br>SDIMP # SIG<br>TEST I SIG<br>TRAM3 I SIG                                                                                                                                                                                                 |
| SPARA   | S <sup>‡</sup> i | 1 Matriz of adjustable parameter sensitivities<br>(including all parameters)         | /PARAM /( 15)  | ADJUST I SPARA<br>PAVOZ I SPARA<br>STAU M SPARA<br>TOPM D SPARA                                                                                                                                                                                         |
| SQRT    |                  | F Square root function                                                               | /SDRT /(\$ )   | ANLATM F SQRT CRASH F SQRT BCTOE F SQRT DERSA F SQRT ENVPRM F SQRT MODELA F SQRT MODELA F SQRT MODELA F SQRT MODELL F SQRT OUT F SQRT PATOS F SQRT PAYD2 F SQRT PAYD2 F SQRT POYSA F SQRT STORE F SQRT STORE F SQRT STORE F SQRT                        |
|         |                  |                                                                                      | /SIZING/( 319) | PAYOZ I SVDPSQ                                                                                                                                                                                                                                          |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                                                  | S T (<br>BLOCK | ORAG | E<br>LOC |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         | E USAGE<br>E VAR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------|----------------|------|------------------------------------------------------------------------------|----------------|------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S2INV             | [\$\$]         | rt 1 | Parameter sensitivity contribution to A matrix                               | /PARAM         | ĸ    | 276)     | ADJUST<br>MTX3A<br>PAYO2<br>TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | O A A B                                 | 521NV<br>521NV<br>521NV<br>521NV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| #TP               | [Y]            |      | Adjustable parameter diagonal seighting matrix<br>order according to IPOINT. | /PARAM         | /(   | 132)     | MTX3A<br>PAY02<br>SDINP<br>TOPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | I<br>I<br>O<br>D                        | WTP<br>WTP<br>WTP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| XM                |                | រេ ! | linor of B matrix                                                            | /PAY02         | /(+  | )        | PAY02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | W                                       | XR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| UNO6.             |                |      | Fall output data                                                             | / UN06         |      | ,        | BUNDANCE PROPERTY OF THE PROPE | 000000000000000000000000000000000000000 | . BNO6 UNO6 |

```
PROGRAM PAYD2
   1.2.3.45.67.89
  FAY82
  CCC
  COMM
COMM
COMM
  COMPUTES PAYOFF IMPROVEMENT
   COMMON /XCODES/
*ITO (9),1COR
*JST (20)
*I2OP ,1COP
  XCODES
XCODES
  CODES/
), ICOR (20), ITI , INTB , JG10(20,2), JPH (
), ICOP , IFAM , IFAR , IFB , IND
, ICOP , IFAM , IFAR , IFB , IND
, IPH , ISPH , ISST , IARC , ISTAR
, ITER , IVAR , JK , JPS , JS
, KPST , K , KST , HAD , NCASE
, NEDB , NED , NOP , IPH , ISTAR
, IBLKI , IBLKZ , ISTOP , ISTPP L
, NB , LB , MB , NPHP , NPHB
, NEOF , ILAB(8), JPRP, JG11, MTT, MPIN(20), JP1, JP2, JP3
  JGIO(20,2), JPH (20,2), NSAB , NICNB , IFB , IND , ISTART , JPS , JS , NAD , NCASE , NPH , ISTAPP , IS
   XCODES
XCODES
XCODES
   *IOPEN
   *IOPEN
*ITCT
*KOP
*NCN
*NST
*IPHNB
*IFOB
*NCTIN
  10.
11
12.
   XCODES
XCODES
XCODES
XCODES
XCODES
  13.
14.
15.
16.
   GLOBAL
GLOBAL
GLOBAL
  16.
19.
20.
21.
22.
23.
  YAUAF
   , LUM
, IB(4)
  , NFARC
  SLOBAL
SLOBAL
RETAP
   IPFL62, IPFL63, IPFL64, INEQFL(20)
   TOL(9) , SVAR(10) , COTI(9,9) , DCOM(9) , DFSO , RO , CSR , WAR , TOP , 
  SENF
   ,WDC(20)
DTP
,QS
,CS
,SUMSQ
,TR(9)
,W
,OMP
,TBU(20)
,MACHY
  SENF
  25.
26.
27.
28.
29.
30.
31.
32.
  GENF
GENF
GENF
GENF
GENF
GENF
GENF
GENF
  34.
35.
  DRAGR
ISP
ULFTR
XMCGM
DELTAE
   DRAGA
ISPF
JULFTA
, CODAE
  SENF
SENF
SENF
  DBR
ULFT
XMCSR
CALPHA
   DHAGV
DB
ULFTV
XMCGA
CDE
ZCG
  36.
37.
38.
39.
40.
42.
43.
45.
   , XMCGV
, CT
, SIDAE
/ GÉNF /
, XJR
, IRATED
   *XMCS
*CULFT
  GENF
GENF
   +COD
COMMON
  , GH
   , SAMMAD
   *XJY
  , XKG
   , XKP
  SENF
   *FRATER
  GENF
SENF
  XK1
XK1D
XK1V
XK1P
XK10
XX1M
PR
  2 , XX3

2D , XX3D

2V , XX3D

2P , XX3P

2D , XX3D

2R , XX3D

2D   XK2D
XK2V
XK2V
XK2P
XK2D
XK2H
  SENF
  SENF
SENF
SENF
  46.
  89012345678901234565
  GENF
GENF
SENF
FRAT
GENF
  , PD
   GENF
STS
STS
STS
  PAYO2
PARAM
PARAM
  PARAM
PARAM
AAA
PHISZ
  PHISZ
PAYOZ
COMN
COMN
  68.
69.
70.
71.
72.
73.
74.
  FINI
PAYUZ
PHISZ
PAYUZ
   30
   SS=0.
DO 10 J=1,NPARA
  PAY02
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```

```
76.
77.
78.
79.
  SS= SS + SPARA(I,J)*SPARA(M,J)/ HTP(J)
10 CONTINUE
S21NY(I,N) = SS
20 CONTINUE
   PAY02
  PAYOZ
   PAY02
COMN
PAY02
PAY02
PAY02
PAY02
PAY02
PAY02
  30 CONTINUE
11 TEST FOR MATRIX COMPRESSION
  86
81
82.
   C
  11 TEST FOR MATRIX COMPRESSION
NO =0
00 50 I=1,MCM
IF(A(I,I).E0.0..AND.SZINV(I,I).E0.0.) GO TO 40
JJ(I)=1
ND =NO +1
NO =NO +1
  83.
84.
85.
   46-
   DSQ(NO)= DCON(1)
50 TO 50
   50-
  89.
  PAY02
  0=(1)LL 0P
  40 JJ(1)=0

50 CONTINUE

111 STORE COMPLETE COMPRESSED MATRIX IN B
1A=0

D0 70 I=1,NCH
IF(JJ(1)-E0.0) G0 T0 70

IA = IA+1

D0 60 J=1,NCH
IF( JJ(J)-E0.0) G0 T060

IB= IB+1
B(IA,IB)= A(I,J) -52INV(I,J)
  90.
  PAY02
   PAYO2
COMN
PAYO2
PAYO2
PAYO2
PAYO2
PAYO2
PAYO2
PAYO2
PAYO2
  91
92
93
95
95
96
97
98
  70
   60-
  100.
  161.
   60 CONTINUE
  PAY02
  1G2.
  PAY02
COMM
   70 CONTINUE
   CONTINUE

IV INVERT B

IF(NO ST.1) SO TO 80
B(1,1)=1./B(1,1)
SO TO 110
  103.
104.
105
106
   C
  PAYU2
PAYU2
PAYU2
PAYU2
  80-
   80 CONTINUE
CALL SYMMRT( B, ND, IER)
IF(IER.NE.0) 50 T0 270
V RESTORE B T0 FULL SIZE
DD 100 I=1 HD
DD 90 J=I MD
90 B(I, J) = B(J, I)
100 CONTINUE
  107.
   PAYO2
PAYO2
PAYO2
COMM
PAYO2
PAYO2
PAYO2
   109.
110.
111.
  270
   112
113
114
  PAY02
  110 CONTINUE

110 CONTINUE

111 IF NOT FIRST OPT PASS GO TO VI-B
111 (120P.NE.1) GO TO 120
111 (1PASS.LE.2) GO TO 115

112 DURING SIZING LOOP RESET METRIC
113 (140 CONTINUE C
   PAYOZ
COMN
PAYOZ
PH1SZ
PH1SZ
PH1SZ
PH1SZ
FINI
PH1SZ
PH1SZ
PH1SZ
  115.
116. C
117.
118.
  120.
115.
  119.
120.
121.
122.
  123.
124.
125.
  IJOP=1
I2OP =2
60 TO 120
  120
   126
127. C
128.
129.
130.
131.
132. C
133. C
  115 CONTINUE
VI-A FIRST OPT_ PASS
OPSO= DCONFNCM)++2+8(H0,H0)
120P =2
   PH15Z
  COMM
  COMN
PAYOZ
PAYOZ
PAYOZ
PAYOZ
COMN
  00=DCON( NCM)
60 TO 190
   190-
   VI-B NORMAL LOGIC
IF CONSTRAINTS 60 TO VI-E
   COMN
COMN
   126 CONTINUE
   135.
   PAY02
  TF(ND.GT.1) GO TO 200

VI-C PAYOFF ONLY

CC = SORT(OPSO /BKONO, MO)) +SIG

IF (ABSCOC ) LT.FMIN) ITER =3

IF ( SIGN(1.,DC ).ME.SIG) ITER =3
  PAYO2
COMM
PAYO2
PAYO2
PAYO2
   200-
   138.
   139
  13G IF (ITER.EQ.3) GO TO 140

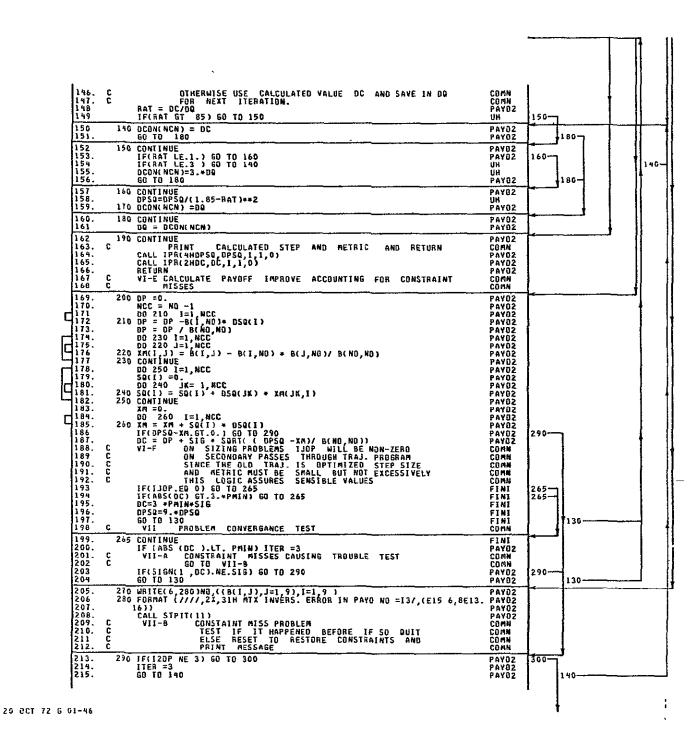
VI-D FAYOFF STEP CONVERSENCE LOGIC

COMPARE CURRENT STEP BITH LAST STEP, IF GREATER

THAN .85 AML LESS THAN 1. SCALE UP MÉTRIC AND USE OLD DO

IF GREATER THAN 3.X DO LIMIT TO 3.
   141
   PAYUZ
   1146-
  COMN
COMN
   0000
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```

553



```
300 12DP = 3

1TER=1

MCN= MCNST

WRITE(6,310)

310 FORMAT (

1S

RETURN

END
   PAYOZ
PAYOZ
PAYOZ
PAYOZ
52HO PAYOFF LOSS PREDICTED, REDUCE CONSTRAINT HISSE PAYOZ
PAYOZ
PAYOZ
PAYOZ
PAYOZ
PAYOZ
216.
217.
218.
219.
220.
221.
222.
223.
```

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# SUBRØUT I NE PDBC

#### Subroutine PDBC

## Purpose

This subroutine computes functions of state and a partial derivative for cut-off, constraint and payoff targets.

## Description

PDBC (and PDBCQL in the quasi-linearization module) contains the equations for all function target conditions available in the trajectory program. These target conditions include the orbital injection parameters, entry range and special targets described in Section 5 of Volume I.

A key feature of the logic in this routine is concerned with the dependance of orbital parameters on one another. This is accommodated by using masking functions to trigger computation of the parameters needed to calculate the desired function.

An example might be when PDBC is called with the variable code argument, KK = 17 meaning eccentricity is to be calculated. The equation sequence necessary for this computation is:

Therefore the masking of variable MM and MASK1, MASK2, and MASK6 is non zero and MM is less than MASK7.

| FORTRAN<br>Symbol  | MATH<br>Symbol         | COD         | E DESCRIPTION                            | <del>,</del> | STORAG<br>BLOCK | LOC  | <u> </u>                                                                                  | COC         | E USAGE                                                                                                    |
|--------------------|------------------------|-------------|------------------------------------------|--------------|-----------------|------|-------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------|
|                    |                        |             |                                          |              |                 |      |                                                                                           |             |                                                                                                            |
| AINCL              | ı                      | M           | Orbital Incilnation                      | (RAD)        | /ORBIT /(       | 7)   | OUT<br>PDBC                                                                               | I           | AINCL<br>Aincl                                                                                             |
| ALT                | h                      | 1           | Altitude                                 |              | /STATE3/(       | 3)   | EQUA3<br>OUT<br>PDBC                                                                      | I<br>I<br>I | ALT<br>ALT<br>ALT                                                                                          |
| ANORLY             | \$                     | Ħ           | Your anomaly                             | (RAB)        | /ORBIT /C       | 13)  | OUT<br>PDBC                                                                               | I           | ANOMLY<br>ANOMLY                                                                                           |
| APOSEE             | R <sub>s</sub>         | 0           | Apogee radius                            | (FT)         | /ORBIT /(       | 11)  | OUT<br>PDBC                                                                               | I<br>O      | APOGEE<br>APOGEE                                                                                           |
| ARGP               | <i>B</i> p             | M           | Orbital argument of perigee              | (RAD)        | /GRBIT /(       | 8)   | OUT<br>POBC                                                                               | 1           | ARGP<br>ARGP                                                                                               |
| ASCNOD             | Ω                      | ĸ           | Longitude of *scending mode              | (RAD)        | /ORBIT /(       | 9)   | OUT<br>POBC                                                                               | I           | ASCNOD<br>ASCNOD                                                                                           |
| ASYMP              | е                      | Ħ           | Outgoing asymptote                       | (RAD)        | /ORBIT /C       | 16)  | PDBC                                                                                      | ĸ           | ASYAP                                                                                                      |
| CAPX               | x                      | 0           | Asymptote parameter                      | ĭ            | /ORBIT /C       | 14)  | POBC                                                                                      | 8           | CAPE                                                                                                       |
| CAPY               | Y                      | 0           | Asymptote parameter                      | (FT)         | /0881T /(       | 15)  | POBC                                                                                      | D           | CAPY                                                                                                       |
| COSOMU             | cos(µ-µ_)              | B           | See symbol                               |              | /ORBIT /C       | 163) | POBC                                                                                      | R           | COSDAU                                                                                                     |
| COSGAM             | C D S( 7 )             | 1           | See symbol .                             |              | /5TATE3/(       | 687) | ACCEL<br>BL8<br>BL8 DER3A<br>EQUA3<br>MODELA<br>MODELB<br>OUT<br>POBC<br>PDY3A            |             | COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM |
| COSPSI             | cos(∲)                 | I           | See symbol ,                             |              | /STATE3/(       | 705) | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>PDBC<br>PDY3A                  |             | COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI                     |
| COSRHO             | cοs(ρ)                 | 1           | See symbol                               |              | /STATE3/(       | 797) | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELA<br>MODELB<br>OUT<br>POBC<br>PDY3A |             | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO |
| CPSII              | cos( $\psi_{t}$ )      | M           | Cosine of inertial azimuth               |              | /ORBIT /C       | 157) | POBC                                                                                      | R           | CP511                                                                                                      |
| CSANO              | cos(\$)                | <b>P</b> 4. | See symbol -                             |              | /DRBIT /E       | 162) | PDBC                                                                                      | n           | CSANO                                                                                                      |
| cset               | cos(7 <sub>1</sub> )   | Ħ           | Cosine of inertial flight path angle     |              | /ORBIT /C       | 155) | POBC                                                                                      | ĸ           | CSGI                                                                                                       |
| CSI                | cos(i)                 | M           | Cosine of inclination                    |              | /ORBIT /C       | 159) | PDBC                                                                                      | ĸ           | CSI                                                                                                        |
| CSPSA              | cos(\nu_r)             | 1           | Cosine of reference azimuth              |              | /ORBIT /(       | 153) | PDBC<br>REU3                                                                              | I           | CSPSR<br>CSPSR                                                                                             |
| CSXLMR             | cos(ρ-ρ <sub>r</sub> ) | ī           | Cosine of refernece latitude             |              | /ORBIT /C       | 147) | POBC<br>REU3                                                                              | I<br>O      | CSXLMR<br>CSXLMR                                                                                           |
| DANDG              |                        | 0           | Partial derivative of boundary condition |              | /DRBIT /C       | 104) | PDBC                                                                                      | 9           | DANDS                                                                                                      |
| DANDH              |                        | 0           | Partial derivative of boundary condition |              | /DRBIT /¢       | 105) | PDBC                                                                                      | 0           | DANDH                                                                                                      |
| DANDM              |                        | Û           | Partial derivative of boundary condition |              | /ORBIT /(       | 1063 |                                                                                           | D           | DANDM                                                                                                      |
| DANDMU<br>8 NOV 72 | 6 01-46                | 0           | Partial derivative of boundary condition |              | /ORBIT /C       | 109) | PDBC                                                                                      | 0           | DANDMU                                                                                                     |

| FORTRAN        | MATH   | CODE DESCRIPTION                            | STORAGE       | 20280    | E USAGE |        |
|----------------|--------|---------------------------------------------|---------------|----------|---------|--------|
| SYMBOL         | SYMBOL | CODE DESCRIPTION                            | BFOCK FO      | C SUBR   | CODE    | VAR    |
| _              | _      |                                             |               |          | _       |        |
| DANDPS         |        | O Partial derivative of boundary condition  |               | 7 PDBC   | 0       | DANDPS |
| DANDRO         |        | O Partial derivative of boundary condition  |               | 8) POBC  | 0       | DANDRO |
| DANBY          |        | 8 Partial derivative of boundary condition  |               | 3) PDBC  | 0       | DANDV  |
| DAPDG          |        | O Partial derivative of boundary condition  |               | O) PDBC  | 0       | DAPDS  |
| DAPDH          |        | O Partial derivative of boundary condition  |               | 1) PDBC  | 8       | DAPDH  |
| DAPDM          |        | O Partial derivative of boundary condition  |               | 2) PBBC  | 0       | DAPDH  |
| DAPDRU         |        | B Partial derivative of boundary condition  |               | 5) PDBC  |         | DAPDRU |
| DAPOPS         |        | 8 Partial derivative of boundary condition  | • • • • • • • | 3) PD60  | 0       | DAPDPS |
| DAPDRO         |        | 8 Partial derivative of boundary condition  |               | 4) POBC  | -       | DAPORO |
| DAPOV          |        | D Partial derivative of boundary condition  | **            | 9) POBC  | 0       | BAPD¥  |
| DASDG          |        | O Portial derivative of boundary condition  |               | 5) PDBC  | 0       | BASDG  |
| DASDH          |        | O Partial derivative of boundary condition  |               | (6) PDBC | -       | DASDH  |
| DASDM          |        | O Partial derivative of boundary condition  |               | 7) PDBC  | -       | DASDM  |
| DASDAU         |        | O Partial derivative of boundary condition  | /ORBIT /( 13  | O) POBC  |         | ĐA5DMU |
| DASDPS         |        | B Partial derivative of boundary condition  |               | 8) POBC  | -       | DASDPS |
| DASDRO         |        | O Partial derivative of boundary condition  | /ORBIT /( 12  | 9) POBC  | Đ       | DASDRO |
| DASDV          |        | B Partial derivative of boundary condition  | /ORBIT /( 12  | 4) POBC  | 0       | DASDV  |
| DOEDG          |        | O Partial derivative of boundary condition  | /ORBIT /(* 6  | 9) PDBC  | 0       | DBEDG  |
| 98EDH          |        | O Partial derivative of boundary condition  | /ORBIT /( 7   | O) PDBC  | 0       | DBEDH  |
| BEDM           |        | B Partial derivative of boundary condition  | /ORBIT /( 7   | 1) PDBC  | 0       | DBEDM  |
| BEDMU          |        | O Partial derivative of boundary condition  | /ORBIT /( 7   | 43 PBBC  | 0       | DBEDMU |
| BEDPS          |        | O Partial derivative of boundary condition  | /ORBIT /(     | 2) PD8C  | Ð       | DBEDPS |
| BEDRO          |        | O Partial derivative of boundary condition  | /ORBIT /( 1   | 39 PD8C  | 0       | DBEDRO |
| BEDV           |        | O Partial derivative of boundary condition  | /ORBIT /( 8   | 8) PDBC  | 0       | DBEDV  |
| CXOG           |        | O Partial derivative of boundary condition  | /ORBIT /( 11  | 1) POBC  | Û       | DCXDG  |
| DEXDH          |        | D. Partial derivative of boundary condition | /ORBIT /( 11  | 2) POBC  | 8       | BCXDH  |
| CXDA           |        | O Partial derivative of boundary condition  | /ORBIT /( 11  | 3) PDBC  | 0       | DCXDM  |
| CXDAU          |        | O Partial derivative of boundary condition  | /ORBIT /( 1)  | 6) POBC  | 8       | DCXDMU |
| CXDPS          |        | O Partial derivative of boundary condition  | /ORBIT /( 11  | 4) POBC  | 0       | DCXDPS |
| CXORO          |        | O Partial derivative of boundary condition  | /ORBIT /( 11  | 5) POBC  | 0       | DCXDRO |
| DCXDY          |        | O Partial derivative of boundary condition  | /ORBIT /( 11  | O) POBC  | 0       | DCXDV  |
| CYD6           |        | O Portial derivative of boundary condition  | /ORBIT /( 11  | B) POBC  | 0       | DCYDG  |
| CYDH           |        | O Partial derivative of boundary condition  | /ORBIT /( 11  | 91 PD8C  | 0       | ВСУВН  |
| CYDM           |        | O Partial derivative of boundary condition  | /ORBIT /( 12  | O POBC   | 0       | DCYDM  |
| CYDAU          |        | O Partial derivative of boundary condition  | /ORBIT /( 12  | 3) POBC  | 0       | DCYDMU |
| DCYDPS         |        | O Partial derivative of boundary condition  | /ORBIT /( 12  | 1) POBÇ  | 8       | DCYDPS |
| OROYORO        |        | O Partial derivative of boundary condition  |               | 23 PDBC  | 0       | DCYDRO |
| CYDV           |        | O Partial derivative of boundary condition  | /ORBIT /( 1)  | 7) PDBC  | 0       | DCYDY  |
| DECOG          |        | M Partial derivative of boundary condition  |               | 5) PDBC  | н       | DECD6  |
| SECOH          |        | M Partial derivative of boundary condition  |               | 6) POBC  | R       | DECDH  |
| DECOM          |        | O Partial derivative of boundary condition  |               | 7) POBC  | Ð       | DECOM  |
| ECOMU<br>DECOM |        | O Partial derivative of boundary condition  |               | D) PDBC  | 0       | DECOMU |
| DECORS         |        | M Partial derivative of boundary condition  |               | B) PDBC  | A       | DECDPS |
| DECORD         |        | M Partial derivative of boundary condition  | -             | 9) PBBC  |         | DECDRO |
| DECOMO         |        | M Partial derivative of boundary condition  |               | 4) POBC  |         | DECDV  |
| DENDG          |        | O Partial derivative of boundary condition  |               | 2) PDBC  | 0       | DENDG  |
| DENOH          |        | O Partial derivative of boundary condition  |               | 39 PD8C  | 0       | DENDH  |
|                |        | O Partial derivative of boundary condition  |               | 4) PDBC  | 0       | DENDM  |
| DENDM          |        |                                             |               |          |         |        |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE    | DESCRIPTION                         | <u>Storage</u><br>Block loc | <u> 50880</u><br>5088 | COD    | E VAR  |
|-------------------|----------------|---------|-------------------------------------|-----------------------------|-----------------------|--------|--------|
| 3111000           | 3111000        |         |                                     |                             |                       |        |        |
| DENDPS            |                | 0 Parti | ai derivative of boundary condition | /ORBIT /( 135               | 3 P.08C               | 0      | DENDPS |
| DENDRO            |                |         | al derivative of boundary condition | /QRBIT /( 136               | ) POBC                | Ð      | DENDRO |
| DENDV             |                |         | al derivative of boundary condition | /ORBIT /( 13)               | 1 POBC                | 0      | DENDY  |
| DGID6             |                |         | al derivative of boundary condition |                             | 1 POBC                | #      | 06106  |
| DGIDH             |                |         | al derivative of boundary condition |                             | ) POBC                | e      | DGIDH  |
| DGIDM             |                |         | al derivative of boundary condition |                             | ) PDBC                | 0      | DGIDM  |
| D6104U            |                |         | al derivative of boundary condition |                             | ) POBC                | 0      | DSIDM  |
| DGIDPS            |                |         | al derivative of boundary condition | •                           | ) PBBC                | ĸ      | DGIDP  |
| D61DR0            |                |         | al derivative of boundary condition |                             | ) POBC                | d      | OGIDR  |
|                   |                |         | al derivative of boundary condition | ********                    | ) PBBC                | d      | DSIDV  |
| D61DA             |                | _       | al derivative of boundary condition | . 4                         | ) PBBC                | 15     | DIDE   |
| DIDG              |                |         | <del>-</del>                        |                             | ) POBC                | Ħ      | DIDH   |
| DIDH              |                |         | al derivative of boundary condition |                             | ) PBBC                | ß      | DIDM   |
| DIOM              |                |         | al derivative of boundary condition |                             | ) PBBC                | 0      | DIDMU  |
| DIDMU             |                |         | al derivative of boundary condition |                             | ) PDBC                | ,<br>M | DIDPS  |
| DIDPS             |                |         | al derivative of boundary condition |                             | ) POBC                |        | DIDRO  |
| DIDRO             |                |         | al derivative of boundary condition |                             | ) PD8C                |        | DIDA   |
| DIDA              |                |         | al derivative of boundary condition |                             | ) POBC                |        | DWIDE  |
| DWIDS             |                |         | al derivative of boundary condition |                             |                       | 0      | DHIDH  |
| DMICH             |                |         | al derivative of boundary condition |                             | PDBC                  |        | DWIDW  |
| DAIDA             |                |         | al derivative of boundary condition |                             | PDBC                  | 8      |        |
| DWIDWA            |                |         | al derivative of boundary condition |                             | ) PDBC                | 0      | DMIDA  |
| DMIDPS            |                |         | al derivative of boundary condition |                             | ) PDBC                | 0      | DAIDP  |
| OMI DRO           |                | 0 Parti | al derivative of boundary condition |                             | ) POBC                | 0      | DMIDR  |
| DMIDV             |                | 0 Parti | al derivative of boundary condition |                             | ) PDBC                | D      | DMIDV  |
| 011006            |                | 0 Parti | al derivative of boundary condition |                             | ) PDBC                | 0      | DHODE  |
| DMODK             |                | 0 Parti | al derivative of boundary condition |                             | ) PDBC                | 0      | DMODH  |
| DHODM             |                | 0 Parti | al derivative of boundary condition |                             | ) POBC                | 0      | DMODM  |
| DMODAU            |                | 0 Parti | al derivative of boundary condition |                             | r) PDBC               | Ð      | HOGMO  |
| DMODPS            |                | 0 Parti | ai derivative of boundary condition |                             | ) PDBC                | Đ      | DMODP  |
| DAOORO            |                | 0 Parti | al derivative of boundary condition | /QRBIT /( 143               | ) PBBC                | 0      | DMODR  |
| DHODY             |                | 0 Parti | al derivative of boundary condition | /ORBIT /( 138               | ) PDBC                | 0      | BRODV  |
| DNODS             |                | 0 Parti | at derivative of boundary condition | /ORBIT /( 76                | ) POBC                | 0      | DNDDS  |
| DNOOK             |                | 0 Parti | al derivative of boundary condition | /ORBIT /( 77                | ) PBBC                | 0      | DNODH  |
| DNDDM             |                | 0 Parti | al derivative of boundary condition | /ORBIT /( 78                | 3) POBC               | Ũ      | ривон  |
| UNDONU            |                | 0 Parti | al derivative of boundary condition | /ORBIT /( 8)                | ) POBC                | 0      | DNBDM  |
| DNOOPS            |                | 0 Parti | al derivative of boundary condition | /ORBIT /( 75                | PDBC                  | 0      | DMODP  |
| DNODRO            |                | 0 Parti | al derivative of boundary condition | /08BIT /( 80                | ) PBBC                | 0      | DNODR  |
| DNODY             |                |         | al derivative of boundary condition | /ORBIT /( 75                | ) POBC                | 8      | DNODY  |
| DPDG              |                | M Parti | al derivative of boundary condition | /ORBIT /( 48                | ) PBBC                | 취      | DPDG   |
| орон              |                |         | al derivative of boundary condition | /DRBIT /( 45                | ) POBC                | A      | DPDH   |
| DPDM              |                |         | al derivative of boundary condition | /ORBIT /( 50                | ) POBC                | 8      | DPDM   |
| DPDMU             |                |         | al derivative of boundary condition |                             | ) POBC                | 8      | DPDMU  |
| DPDP5             |                |         | al derivative of boundary condition |                             | ) POBC                | A      | DPDPS  |
| DPDRO             |                |         | al derivative of boundary condition |                             | ) PDBC                | 8      | DPDRO  |
| 02040<br>0204     |                |         | al derivative of boundary condition |                             | ) POSC                |        | DPDV   |
|                   |                |         |                                     |                             | ) PDBC                | 0      | DPEDE  |
| DPEDG             |                |         | al derivative of boundary condition |                             | ) PDBC                | 0      | DPEDH  |
| DPEDH             |                |         | al derivative of boundary condition |                             | ) PDBC                | 0      | DPEDA  |
| DPEDM             |                |         | al derivative of boundary condition |                             |                       | ٥      | DPEON  |
| DPEDMU            |                | 0 Parti | al derivative of boundary condition | /ORBIT /( 102               | ) PBBC                | υ      | nrcor  |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE DESCRIPTION                                                                                        | STORA BLOCK           | GE<br>LOC | SUBRO<br>SUBR                                                        | CODI             | USAGE<br>VAR                            |
|-------------------|----------------|---------------------------------------------------------------------------------------------------------|-----------------------|-----------|----------------------------------------------------------------------|------------------|-----------------------------------------|
|                   |                |                                                                                                         |                       |           |                                                                      |                  |                                         |
| DPEDPS            |                | O Partial derivative of boundary condition                                                              | /ORBIT /(             | 100)      | PDBC                                                                 | Đ                | DPEDPS                                  |
| DPEDR8            |                | O Partial derivative of boundary condition                                                              | /ORBIT /(             | 101)      | PDBC                                                                 | 0                | DPEDRO                                  |
| DPEBV             |                | O Partial derivative of boundary condition                                                              | /ORB11 /(             | 96)       | PDBC                                                                 | 0                | DPEDV                                   |
| DP I D6           |                | M. Partial derivative of boundary condition                                                             | /ORBIT /(             | 34)       | PDBC                                                                 | A                | DPIDE                                   |
| DPIDH             |                | M Partial derivative of boundary condition                                                              | /ORBIT /(             | 35)       | PDBC                                                                 | Ħ                | HOIPO                                   |
| DPIDM             |                | O Partial derivative of boundary condition                                                              | /ORBIT /C             | 36)       | POBC                                                                 | Đ                | MOITO                                   |
| DPIDMU            |                | O Partial derivative of boundary condition                                                              | /ORBIT /(             | 39)       | PDBC                                                                 | ٥ ر              | DPIDMU                                  |
| 071075            |                | M Partial derivative of boundary condition                                                              | /ORBIT /(             | 37)       | PBBC                                                                 | R                | DP1 DP5                                 |
| DPIORO            |                | M. Partial derivative of boundary condition                                                             | /ORBIT /C             | 38)       | PDBC                                                                 | PI,              | DPIDRO                                  |
| OPIDV             |                | M Partial derivative of boundary condition                                                              | /ORBIT /(             | 33)       | POBC                                                                 | R                | DPIDA                                   |
| BSMBG             |                | M Partial derivative of boundary condition                                                              | /ORBIT /(             | 83)       | PDBC                                                                 | Ħ                | DSMD6                                   |
| DSMOH             |                | M Partial derivative of boundary condition                                                              | /ORBIT /C             | 84)       | PDBC                                                                 | ĸ                | DSMDH                                   |
| DSMDM             |                | 8 Partial derivative of boundary condition                                                              | /ORBIT /C             | 85)       | POBC                                                                 | 0                | DSMDM                                   |
| DSMDMU            |                | O Partial derivative of boundary condition                                                              | /ORBIT /(             |           | PDBC                                                                 | 0                | DSADAU                                  |
| DSMDPS            |                | M. Partial derivative of boundary condition                                                             | /ORBIT /(             |           | PDBC                                                                 | Ħ                | DSMDPS                                  |
| OROMZO            |                | R Partial derivative of boundary condition                                                              | /ORBIT /{             |           | PDBC                                                                 | Ħ                | DSMDRO                                  |
| DSMDV             |                | M. Partial derivative of boundary condition                                                             | /ORBIT /(             |           | PDBC                                                                 | Ħ                | DSMDV                                   |
| . aeiva           |                | M Partial derivative of boundary condition                                                              | /ORBIT /(             |           | PDBC                                                                 | M                | DAIDE                                   |
| HOIVE             |                | M Partial derivative of boundary condition                                                              | /ORBIT /(             |           | PDBC                                                                 | M                | DAIDH                                   |
| MOIVO             |                | O Partial derivative of boundary condition                                                              | /ORBIT /(             |           | PDBC                                                                 | 0                | DAIDW                                   |
| DAIDUR            |                | O Partial derivative of boundary condition                                                              | /ORBIT /(             | -         | PDBC                                                                 | 0                | DAIDWR                                  |
| DVIDPS            |                | M. Partial derivative of boundary condition                                                             | /ORBIT /(             |           | PDBC                                                                 | ĸ                | DVIDPS                                  |
| DVIDRO            |                | M Partial derivative of boundary condition                                                              | /ORBIT /(             |           | POBC                                                                 | Ħ                | DVIDRO                                  |
| DAIDA             |                | M Partial derivative of boundary condition                                                              | /ORBIT /C             | 19)       | POBC<br>Pobc                                                         | Ħ                | DAIDA<br>Daida                          |
| ECC               | ¢              | M Orbital accentricity                                                                                  | /ORBIT /(             | 6.3       | DUT<br>PDBC                                                          | I                | ECC                                     |
| ENERGY            | E              | 0 Energy                                                                                                | /ORBIT /(             | 17)       | OUT<br>PDBC                                                          | I                | ENERGY<br>ENERGY                        |
| ER                | E <sub>R</sub> | I Earth radius. (f                                                                                      | T) /GLOB <b>AL/</b> ( | 2)        | COORDS<br>CRASH<br>EQUA3<br>GEINP<br>PADS1<br>PDBC<br>SOMB<br>TRTOSZ | 1 1 1 1 1 1 1    | ER<br>REM<br>ER<br>ER<br>ER<br>ER<br>ER |
| F                 |                | M Value of boundary condition function or array of<br>state derivatives                                 | /PDBC /(4             | • )       | POBC                                                                 | Ħ                | F                                       |
| GAMI              | 71             | O Inertial flight path angles (RA                                                                       | D) /ORBIT /(          | 2)        | OUT<br>Pobc                                                          | I<br>D           | Gami<br>Gami                            |
| GD                | 7              | I GAM derivative                                                                                        | /STATE3/(             | 16)       | DER3A<br>PDBC                                                        | 0                | 60<br>60                                |
| GM .              | GM             | I Product of Newton's universal gravitational constant and the wass of the earth. (FT <sup>3</sup> /SEC | /GLOBAL/(             | 67)       | CRASH<br>OUT<br>PADS1<br>PDBC                                        | I<br>I<br>O<br>I | 64<br>64<br>64<br>64                    |

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| FORTRAN    | MATH     |   |                                                                              |                                      | STORAG    | AGE SUBROUTI |                                                                                                                                           |                  | E USAGE                                                      |
|------------|----------|---|------------------------------------------------------------------------------|--------------------------------------|-----------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------|
| SYMBOL     | SYMBOL   |   | DESCRIPTION                                                                  |                                      | BLOCK     | FOC          | SUBR                                                                                                                                      | COL              | E VAR                                                        |
| SR         | 9,       | ı | Gravitational acceleration at surface of                                     | the earth.<br>(FT/SEC <sup>2</sup> ) | /GLOBAL/( | 1)           | ACCEL<br>BL5<br>FH3<br>GE1NP<br>GE1NP<br>GE1NP<br>GE1NP<br>GE1NP<br>GE1NP<br>SIZE<br>SIZI<br>SIZI<br>SIZI<br>SIZI<br>SIZI<br>SIZI<br>SIZI |                  | 66666616688888888888888888888888888888                       |
| но         | ĥ        | I | ALT derivative                                                               |                                      | /STATE3/( | 17)          | DER3A<br>PDBC                                                                                                                             | õ                | HD<br>HD                                                     |
| HHNTH      | н        | Ħ | Momentum                                                                     |                                      | /ORBIT /( | 18)          | OUT<br>Pobc                                                                                                                               | I                | ntkah<br>Atkah                                               |
| HTD        | ů        | 1 | Heating derivative                                                           |                                      | /STATE3/( | 22)          | DERSA<br>OUT<br>PDBC<br>PDYSA                                                                                                             | 0<br>I<br>I      | HTD<br>HTD<br>HTD<br>HTD                                     |
| EATM       | ,        | ī | Atmosphere option flag                                                       |                                      | /ARCDAT/( | 7)           | EQUAS<br>FXDAT<br>OUT<br>PDBC<br>VT                                                                                                       | 1<br>1<br>1<br>1 | NTAI<br>NTAI<br>NTAI<br>NTAI                                 |
| 102        |          | I | Option code                                                                  |                                      | /PDBC /(+ | 3            | PDBC                                                                                                                                      | 1                | 102                                                          |
| 19FLG1     |          | ī | IPFLGI#O supresses print-out of velocity inertial Euler angles.              | losses and                           | /GLOBAL/( | 69)          | FNTG<br>OUT<br>POBC<br>PRINT<br>TRTOSZ                                                                                                    | I<br>I<br>I<br>O | IPFLG1<br>IPFLG1<br>IPFLG1<br>IPFLG1<br>IPFLG1               |
| ISKP       |          | Ħ | Redundancy flag                                                              |                                      | /PDBC /(# | )            | PDBC                                                                                                                                      | Ħ                | ISKP                                                         |
| RAVI       |          | C | Masking array counterpart (powers of 2)                                      |                                      | /PDBC /(* |              | PDBC                                                                                                                                      | C                | JVAR                                                         |
| (          |          | H | Variable code number                                                         |                                      | /PDBC /(+ | -            | PDBC                                                                                                                                      | <b>H</b>         | K                                                            |
| K<br>MASK  |          | 1 | Variable code number                                                         |                                      | /PDBC /(* |              | PDBC                                                                                                                                      | I                | KK                                                           |
| 1432<br>1j |          | ī | Masking array for dependency calculation operameters and partial derivatives | 0 T D T D I T                        | /PDBC /(+ |              | PDBC                                                                                                                                      | В                | MASK                                                         |
| טר         | μ        | • | Longitude                                                                    |                                      | /STATE3/( | 1,           | DUT<br>PDBC                                                                                                                               | I<br>I           | ru<br>Hü                                                     |
| OCORHO     | w×C0SRH0 | I | See symbol                                                                   |                                      | /STATE3/( | 708)         | DERSA<br>EQUAS<br>MODELA<br>MODELB<br>PDBC<br>PDYSA                                                                                       |                  | OCORHO<br>OCORHO<br>OCORHO<br>OCORHO<br>OCORHO               |
| BAGZ       | ω        | ī | Earth rotation rate                                                          | (RAD/SEC)                            | /GLOBAL/( |              | ADID3A<br>CRASA<br>DER3A<br>EQUA3<br>GEINP<br>MODELA<br>MODELB<br>POBC<br>POY3A<br>SOIMP<br>TOPM                                          | I<br>I<br>I<br>I | OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ |
| RBPRM      | ٧i       | I | Inertial velocity                                                            | (FT/SEC)                             | /ORBIT /( |              | OUT<br>PDBC<br>POBC                                                                                                                       | I<br>I           | VI<br>ORBPRM                                                 |

| FORTRAN<br>Symbol | MATH<br>Symbol         | COD | DESCRIPTION                                | ·         | BLOC    | 08 A ( | FOC  | SUBROI<br>Subr                                                                     | COD                   | E USAGE<br>E VAR                                                                       |
|-------------------|------------------------|-----|--------------------------------------------|-----------|---------|--------|------|------------------------------------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------|
| P                 | · Pr                   | M   | Semi-latus rectum                          | (FT)      | /ORBIT  | /(     | 5)   | OUT<br>PDBC                                                                        | I                     | P<br>P                                                                                 |
| PA                | Pa                     | 1   | Atmospheric pressure                       | (PSF)     | /GENF   | K      | 308) | EQUA3<br>FH2<br>IMPUL<br>OUT<br>POBC<br>SDER3                                      | M<br>I<br>I<br>I<br>I | DZM<br>PA<br>PA<br>PA<br>PA<br>PA                                                      |
| PERGEE            | Rp                     | 0   | Perigee radius                             | (FT)      | /ORBIT  | 70     | 12)  | OUT<br>Pobc                                                                        | 1<br>0                | PERSEE<br>PERSEE                                                                       |
| PPO               |                        | ī   | Partial derivative of boundary condition   |           | /ORBIT  | /(     | 19)  | PDBC<br>PDBC                                                                       | M                     | DVIDV<br>PPO                                                                           |
| PSII              | $\Psi_{\mathbf{i}}$    | M   | Inertial axiauth                           | (RAD)     | /ORBIT  | 70     | 3)   | OUT<br>Pobc                                                                        | ĭ                     | PSII<br>PSII                                                                           |
| e                 | q                      | 1   | Dynamic pressure                           | (PSF)     | /GENF   | K      | 303) | ENVPRA<br>EQUAS<br>OUT<br>PDBC<br>VT                                               | H<br>I<br>I<br>I      | 0<br>0<br>0                                                                            |
| R                 | R                      | I   | Radial distance from earth center to vehic | le (FT)   | /GENF   | /(     | 305) | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>PDBC<br>PDY3A<br>TRTOSZ | I<br>I<br>I           | R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R                                              |
| RE                | R <sub>ey</sub>        | M   | Unit reynolds number                       | (1/FT)    | /GENF   | /(     | 306) | OUT<br>PDBC                                                                        | ri<br>Fi              | RE<br>RE                                                                               |
| RO                | ρ,                     | 1   | Atmospheric density (SLU                   | C5/FT**3) | /GENF   | /(     | 309) | BL7<br>BL8<br>DER3A<br>EQUA3<br>OUT<br>PDBC<br>PDY3A                               | I<br>I<br>I<br>I<br>I | RO<br>RO<br>RO<br>RO<br>RO<br>RO<br>RO                                                 |
| ROR               |                        | I   | Deriv. Of density ort alt.                 |           | /GENF   | /(     | 313) | BLT<br>BL8<br>EQUA3<br>PD8C<br>PDY3A                                               | I<br>I<br>I<br>I      | ROR<br>ROR<br>ROR<br>ROR<br>ROR                                                        |
| 5                 |                        | ĸ   | Partials of boundary conditions            |           | /PDBC   | /(+    | 3    | PDBC                                                                               | Ħ                     | S                                                                                      |
| SCROSS            | s <sub>c</sub>         | 0   | Cross range                                | (FT)      | /ORBIT  | /(     | 149) | OUT<br>PDBC                                                                        | I<br>O                | SCROSS<br>SCROSS                                                                       |
| SB                | _                      | ĸ   | Rate of change of boundary condition funct |           | /PDBC   | /(+    |      | PDBC                                                                               | Ħ                     | SD                                                                                     |
| SOOWN             | So                     | 0   | Bown range                                 | (FT)      | /ORBIT  |        | 148) | POBC                                                                               |                       | SDOWN<br>SDOWN                                                                         |
| SINDMU            | sin(μ-μ <sub>r</sub> ) | M   | See symbol                                 |           | /DRBIT  |        | 164) |                                                                                    | Ħ                     | SIADAU                                                                                 |
| S I NGAM          | sin(7)                 | I   | See symbol                                 |           | /STATE: | 3/(    |      | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELB<br>PDBC<br>PDY3A<br>SDER3  | 1<br>1<br>1<br>1      | SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM<br>SINGAM |

8 NOV 72 6 01-46

| FORTRAN<br>Symbol | MATH<br>Symbol         | CODE | DESCRIPTION                                                                                | STORA<br>Block | GE<br>LOC | SUBADU<br>SUBR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                             |                                                                                     |
|-------------------|------------------------|------|--------------------------------------------------------------------------------------------|----------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| SINPSI            | sin(ψ)                 | 1    | See symbol                                                                                 | /STATE3/(      | 764)      | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELA<br>PDBC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | I<br>I<br>I<br>I<br>I                                                                       | SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI<br>SINPSI        |
| S I NR HÓ         | sin(ρ)                 | 1    | See symbol                                                                                 | /STATE3/(      | 706)      | PBY3A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I<br>I | SINPSI SINRHO |
| SMIMAJ            | a <sub>s</sub>         | M    | Semi-major axis (FT)                                                                       | /ORBIT /(      | 10)       | OUT<br>POBC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1                                                                                           | SMIMAJ<br>SMIMAJ                                                                    |
| SNGI              | sin(7,)                | m    | Sine of inertial flight path angle                                                         | /ORBIT /(      | 154)      | POBC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                             | SNGI                                                                                |
| SNGNU             | sin(v)                 | m    | See symbol                                                                                 | /ORBIT /C      | 161)      | POBC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | H :                                                                                         | SNGNU                                                                               |
| SNI               | sin(1)                 | Ħ    | Sine of Inclination                                                                        | /ORBIT /C      |           | PDBC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                             | SNI                                                                                 |
| SNPSR             | sin(♥ <sub>r</sub> )   | 1    | Sine of reference scimuth                                                                  | /ORBIT /(      | 152)      | PDBC<br>Reu3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                             | SNPSR<br>Snpsr                                                                      |
| SNXLMR            | sin(ρ-ρ <sub>ε</sub> ) | 1    | Sine of reference latitude                                                                 | /ORBIT /(      | 146)      | PDBC<br>REU3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                             | SNXLMR<br>SNXLMR                                                                    |
| SPSII             | sin(♥ <sub>t</sub> )   | •    | Sin of inertial axiouth                                                                    | /ORBIT /C      | 156)      | PDBC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                             | SPSII                                                                               |
| 50                |                        | 1    | A synthesis data array (37,5) that contains the flyback data and some injection quantities | /SIZING/(      |           | ENVPRM<br>FLYBXP<br>ISPRAT<br>POBC VA<br>RANGE<br>SIZEMR<br>SIZEMR<br>SIZEM<br>SIZEMR<br>SIZEM<br>TAMPAR<br>THRUST<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TRENDS<br>TREN | 村工工工作00世代工作0年代内内                                                                            | 50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>5     |
| SORT              |                        | F    | Square root function                                                                       | /SQRT /(       | ; )       | MODELA<br>MODELB<br>OPWELL<br>OUT<br>PAT 63<br>PAY 02<br>POBC<br>POY 3A<br>STORE<br>SYMVRT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | +++++++++++++++++++++++++++++++++++++++                                                     | SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT<br>SORT                        |
| STOT              | \$ <sub>T</sub>        | Ð    | Total range (FT)                                                                           | /ORBIT /(      | 158)      | OUT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1 5                                                                                         | ORT<br>Tot                                                                          |
| 8 NOV 7           | 2 G 01-46              |      |                                                                                            |                |           | PDBC<br>TRTOSZ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                             | TOT                                                                                 |

| FORTRAN<br>SYMBOL | MATH<br>Symbol         | COU | E DESCRIPTIO                        | N                | STORA:<br>BLOCK | LOC  | SUBROUT<br>SUBR (                                                                                                                                   | INE USA<br>ODE VA                                                                                 |
|-------------------|------------------------|-----|-------------------------------------|------------------|-----------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| TC                | € <sub>C</sub>         | m   | Cross range angle                   | (RAD)            | /ORBIT /(       | 1517 | POBC                                                                                                                                                | m TC                                                                                              |
| TO                | θ <sub>0</sub>         | Ħ   | Down range angle                    | (RAD)            | /ORBIT /(       | 150) | POBC                                                                                                                                                | M TD                                                                                              |
| THT               | $\theta_{\mathtt{T}}$  | *   | Total range angle                   | (FT)             | /ORBIT /(       | 165) | PDBC                                                                                                                                                | M THT                                                                                             |
| TIME              | t                      | Ī   | Time (elapsed)                      |                  | /GENF /(        | 493) | OUT<br>POBC<br>PROPIN<br>REU3<br>RKTA3A<br>RKTB3A                                                                                                   | I TIME |
| מע                | $\overset{\star}{\mu}$ | 1   | Longitude derivative                |                  | /STATE3/(       | 21)  |                                                                                                                                                     | 0 40<br>1 40                                                                                      |
| ٧                 | •                      | 1   | Relative velocity                   | (FT/SEC)         | /STATE3/(       | 1)   | ACCEL ADICB3 ADJUST ADJUST BL8 ADJUST BL8 BL7 BL8 BL7 BL8 COR3 DENYPRM BUDELA MODELA MODELA MODELA MODELA MODELA REGUAS OUT PDYSS RKTASA STPS TRYPM | I VAR O VAR O VAR I VAR                           |
| <b>V</b> O        | ŷ                      | I   | State vector derivatives in steepes | t descent module | /STATE3/(       | 15)  | DTF3<br>ENVPRM<br>PDBC<br>PROPIN<br>REU3<br>RKTA3A<br>SOER3<br>STP3<br>YREF3                                                                        | I OVAR M DVAR D VD I VT I DVAR I VD D DVAR I DVAR                                                 |
| VE                | Rwcosp                 | W   | See symbol                          |                  | /PDBC /(+       |      | PDBC                                                                                                                                                | H VE                                                                                              |
| A1                | A 1                    | Ħ   | Inertial velocity                   | (FT/SEC)         | /ORBIT /(       | 1)   | PDBC                                                                                                                                                | I VI<br>I ORBPR<br>M VI                                                                           |
| VNR<br>8 NOV 72 I | 6 01-46                | I   | Deriv.of viscosity mrt ait.         |                  | /GENF /(        | 315) | POBC                                                                                                                                                | I VNR                                                                                             |

| FORTRAN<br>Symbol | MATH<br>Symbol | COD | E DESCRIPTION                   | ) N            | ST<br>BLOCK | ORAG | LOC  | SUBROU<br>SUBR                                                 | TIN<br>COD                      | E USAGI      |
|-------------------|----------------|-----|---------------------------------|----------------|-------------|------|------|----------------------------------------------------------------|---------------------------------|--------------|
| VNU               | μ,             | 1   | Atmospheric viscosity Edynamic] | (SLUGS/FT/SEC) | /GENF       | /(   | 311) | OUT<br>PDBC                                                    | 1                               | AMA          |
| <b>Li</b>         | <b>ស</b>       | I   | Weight                          | (LBS)          | /GENF       | /(   | 412) | BL5<br>ENVPRM<br>EQUA3<br>FH3<br>OUT<br>POBC<br>REU3<br>TRTOSZ | I<br>I<br>I<br>I<br>I<br>I<br>I |              |
| IUMX              | $\mu_{1}$      | M   | Inertial longitude              | (RAD)          | /ORBIT      | /(   | 4)   | OUT<br>PDBC                                                    | I                               | IUMX<br>IUMX |
| YMXRF             | $\rho_{\rm r}$ | I   | Reference longitude             | (RAD)          | /ORBIT      | 70   | 145) | PDBC<br>BFU3                                                   | I                               | YMXRF        |

```
SUBROUTINE POBC(KK,F,S,SD,IOP,ISKP)
  1.
2.
3.
4.
5.
7.
89.
112.
113.
115.
118.
                                PARC
   THIS SUBROUTINE COMPUTES FUNCTIONS OF STATE AND PARTIALS FOR VARIOUS PURPOSES IN TABTOP ++ DEFINITIONS++
   PDBC
PDBC
PDBC
   KK = VARIABLE CODE NUMBER
F = VALUE OF FUNCTION
S = PARTIAL DERIVATIVE ARRAY
SD = TIME DERIVATIVE OF F
10P = DPTION FLAS = 0 = COMPUTE F ONLY
1 = COMPUTE S
2 = ESTIMATE SD IF POSSIBLE
3 = COMPUTE SD
1SKP= BYPASS FLAS TO INHIBIT REDUNDANT COMPUTA
  POSC
   PDBC
PDBC
PDBC
PDBC
   POBC
POBC
POBC
POBC
   REDUNDANT COMPUTATION
   POBC
PDBC
   PDBC
ARCDAT
   XISP
JAER
GMDOT
MAED
MXCG
ZCGR
RHOB
   TMULT
JPRO
ALFMAX
MAEE
MZCS
XE
QMULT
  DTNC
OMAX
PHMAX
MAEF
MUDA
ZE
REMAX
  DTPI
GMAX
MAEA
MAEG
MUDB
  ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
20.
21.
22.
23.
24.
25.
  ** FRATE ARCD(9)
DIMENSION ARCDA(40)
EQUIVALENCE(SREF, ARCDA)
COMMON/STATE3/
**VAR(14) DVAR (14) VARL (99) DVARL(99) YO(9) SVY(10)
**XL(9,9) YOE(20,9), VOS (20,9) COSSAM SINGAM SAWBP(15)
**SINPSI COSPSI SINRHO COSRHO DCORHO DCORHO
**SUBV (9) ONEGA DMEGA2
**UDV GDV RDV RDV RDV PDW ODV
**UDR YDS GDG ROS PDG ODE
**UDR YDA GDM MDM PDA ODB
**UDR YDA GDM MDM PDA ODB
**UDR YDA GDM MDM PDA ODB
**DD DDD HTDV HTDR
COMMON/STATE3/
**SIN2RO COS2RO COS2SM
EQUIVALENCE (VAR(1), V) (VAR(2), GAM) (VAR(3), ALT) (VAR(4), M)
**COVAR(1), VD], (DVAR(2), GD), (DVAR(3), HT) (VAR(4), M)
**COVAR(1), VD], (DVAR(7), UD), (DVAR(8), HT) (VAR(4), M)
**COVAR(1), VD], (DVAR(7), UD), (DVAR(9), SQ2D)
**REAL MDM MDV
**COVAR(1), VD], (DVAR(7), UD), (DVAR(9), SQ2D)
**COVAR(1), VD], (DVAR(1), VD], (DVAR(9), SQ2D)
**COVAR(1), VD], (DVAR(1), VD],
   RETAP
ARCDAT
ARCDAT
STATE3D
STATE3D
 28.
29.
30.
   STATE3D
STATE3D
STATE3D
  31.
 33.
34.
35.
   STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
 36.
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 38
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  STATE 3B
   EOUV3
EOUV3
  44547
 4455555555556666666677777775
   GENF
GENF
GENF
   GENF
GENF
GENF
GENF
GENF
GENF
GENF
GENF
  DRAGE
ISP
ULFTE
XACGA
DELTAE
   DRASA
ISPF
ULFTA
CODAE
,510
   DBR
ULFT
XMCGR
CALPHA
XCG
  ULFTV
XMCGA
CDE
ZCG
  , XMCGV
, CT
, SIDAE
GÉNF /
, XJR
, IRATED
   * XACG
   GENF
GENF
   *CULFT
   GENF
   COMMON
*XJV
*FRATED
*P1
   , SH
  , SAMMAD
   , XKG
   ,XKP
   GENE
  , P3
, XK3T
, XK3A
, XK3G
, XK3H
, XK3U
, YK3U
  ,XK1
,XK1D
,XK1V
,XK1P
,XK1D
,XK1M
,PR
  , XK2
, XK2D
, XK2V
, XK2P
, XK2O
, XK2M
, PO
   , P2
, XK2T
, XK2A
, XK2A
, XK2B
, XK2U
, PG
  , XK3
, XK3B
, XK3V
, XK3P
, XK3D
, XK3M
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GENF
GENF
GENF
GENF
GENF
  *XK1T

*XK1A

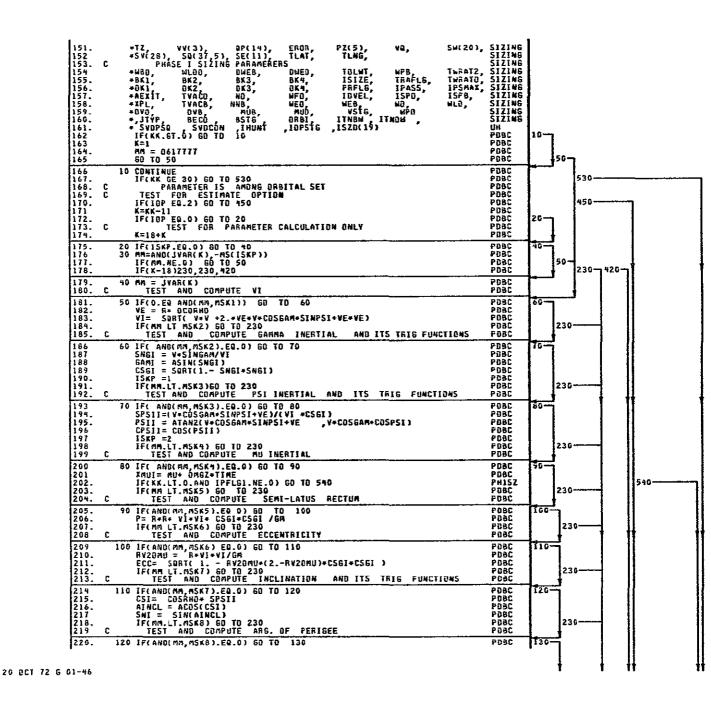
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*XK1R
  *XKIU
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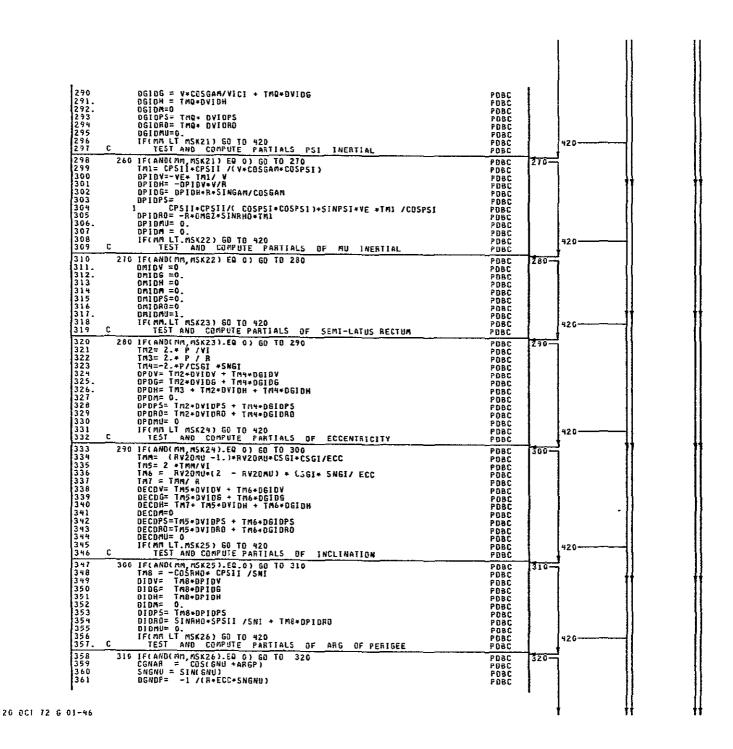
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GENF
FRAT
GENF
GENF
SLOBAL
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82.
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86.
87.
                    GLOBAL
GLOBAL
GLOBAL
GLOBAL
GLOBAL
RETAP
CABIT
ORBIT
   ORBIT
ORBIT
ORBIT
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DPIOPS,
DMIOM,
DECOS,
DIOV,
OIDMU,
DBEDRO,
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DRBIT
DRBIT
ORBIT
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DECDPS,
DIDA,
DBEDH,
DNOD6
   DIDS
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OBEDMU,
DNODRO,
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ORBIT
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ORBIT
   DIDPS , DBEDA ,
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DBEDG ,
DNDOV ,
   DIDRO DBEDPS.
                   HOOMO
  DNODM
  DNODPS.
                     * DNGOV,
* ONODRU,
COMBON/ORBIT/
* DSMORO, D
* DAPDPS, D
* DAPDPS, DP
   DSHDH,
  DSHDV,
   DSMD6,
  DSHBPS
101
103.
104.
105.
106.
107.
108.
   ORBIT
ORBIT
ORBIT
ORBIT
109.
110
111
112
113
114
115
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   DEBLIT
   ORBIT
ORBIT
ORBIT
ORBIT
POBC
POBC
118.
120.
121
122
   PDBC
PDBC
PDBC
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125
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129.
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PDBC
  PBBC
  POBC
  POBC
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  PDBC
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133.
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PDBC
  POBC
  PBBC
PBBC
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150.
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PDBC
SIZING
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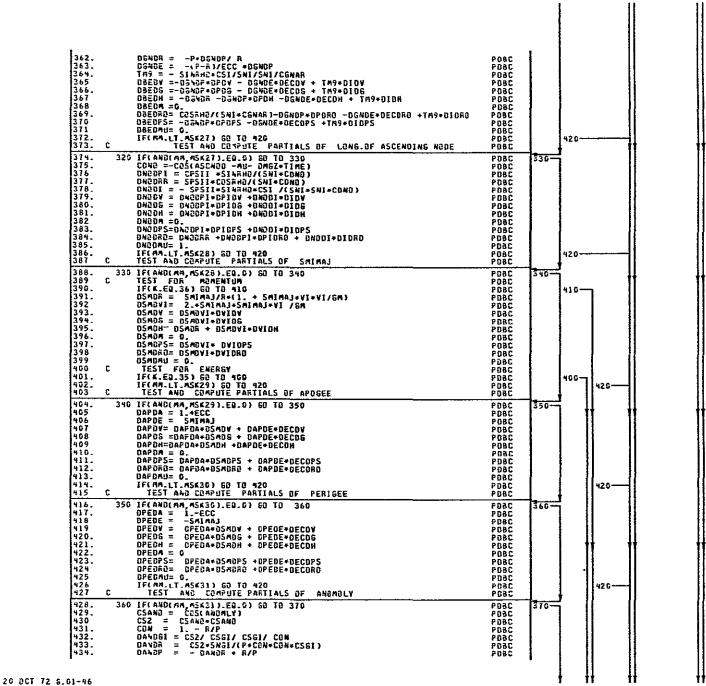
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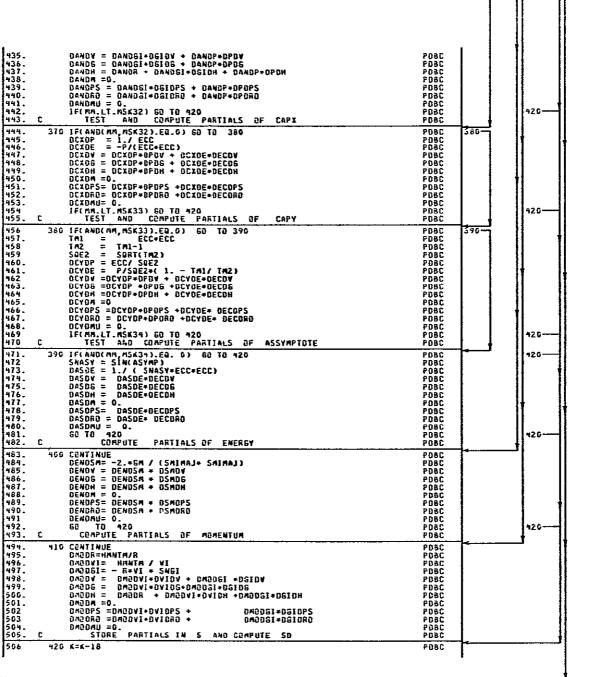


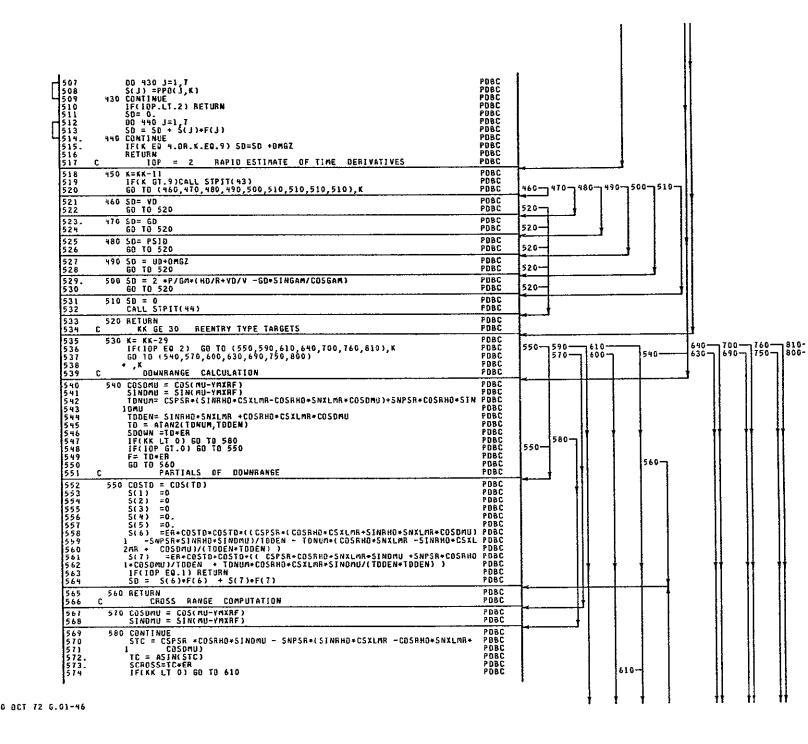
|                                                                                                                                                                                                   |                                                               | ļ    |     |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|------|-----|----------|
| 1. CSGNU =(P -R)/R/ECC 2                                                                                                                                                                          | POBC<br>PH1SZ<br>POBC<br>P214<br>P314<br>P314<br>P315<br>PDBC |      | 236 |          |
| 9 130 IF(AND(MM, MSK9) EQ.O) GD TO 140<br>0. SPSI = SPSII+SINRMO/SNI<br>1. IF(ABS(SPSI) GT.1.) SPSI= SIGN(1.,SPSI)<br>2 ASCNOO = XMUI - ASIN(SPSI)                                                | PDBC<br>PDBC<br>PD14<br>PD14<br>PD14                          | 146- | 320 |          |
| 3. IF(MM LT.MSK10) 50 T0 230 4 C TEST AND COMPUTE SEMI-MAJOR AXIS 5 140 IF(AND(MM,MSK10) E0.0) 60 T0 150 6 SMIMAJ= R*6M /(2.*6M -R*VI*VI) 7. IF(MM LT MSK1) 60 T0 230 8 C TEST AND COMPUTE APOGEE | PD&C<br>PD&C<br>PD&C<br>PD&C<br>PD&C<br>PD&C                  | 156  | 230 |          |
| 9 150 IF(AND(MM,MSK11) EQ.O) GD TO 160<br>0 APOGEE= \$MIAAJ*(1.+ECC)<br>1 IF(MM LT MSK12) GO TO 230<br>2. C TEST AND COMPUTE PERIGEE                                                              | POSC<br>POSC<br>POSC<br>POSC                                  | 166- | 236 |          |
| 3. 160 IF(AND(MM,MSK12).EQ.0) GB TO 170 4. PERGEE = SMIMAJ*(1ECC) 5. IF(MM.LT MSK13) GD TO 230 6. C TEST AND COMPUTE TRUE ANDMOLY 7 170 IF(AND(MM,MSK13) ED 0) GD TO 180                          | 908C<br>908C<br>908C<br>908C                                  | i I  | 230 |          |
| 8 ANDMLY = 'ATAN2( SMGI/CSGI, 1 R/ P ) 9 IF(MM IT.MSK14) 6D TD 230 0 C TEST AND COMPUTE CAP X 1 180 IF(AND(MM,MSK14).EQ.O) 6D TO 190 2. CAPX = P/ECC 3. IF(MM.LT MSK15) 6D TO 230                 | PDBC<br>PDBC<br>PDBC<br>PDBC<br>PDBC<br>PDBC                  | 190- | 230 |          |
| 4 C TEST AND COMPUTE CAPY  5 190 IF(AND(MM,MSK15).E0 0) GO TO 200  6. CAPY = P*ECC / SQRT( ECC*ECC -1)  7 IF(MM LT MSK16) GO TO 230  8 C TEST AND COMPUTE ASSYMPTOTE                              | PDBC<br>PDBC<br>PDBC<br>PDBC<br>PDBC                          | 200  | 230 |          |
| 9 200 IF(AND(MM,MSK16) EQ.O) GD TO 210<br>0 ASYMP = ACOS(1./ECC)<br>1. IF(MM LT MSK17) GD TO 230<br>2. C TEST AND COMPUTE ENERGY                                                                  | POBC<br>POBC<br>POBC<br>POBC                                  |      | 236 | <b> </b> |
| 3. 210 IF(AND(MM,MSK17).EQ.0) 60 TO 220 4 ENERGY = 2 +6M / SMIMAJ 5 IF(MM LT MSK18) 60 TO 230 6 C TEST AND COMPUTE MOMENTUM 7 220 IF(AND(MM,MSK18) EQ.0) 60 TO 240                                | PDBC<br>PDBC<br>PDBC<br>POBC                                  | 220  | 236 |          |
| 8. HMNTR= A+VI+CSGI 9                                                                                                                                                                             | POBC<br>POBC<br>POBC<br>POBC                                  | 240- |     | 540      |
| 3. AETURN 4 C TEST AND COMPUTE PARTIALS OF V INERTIAL 5 240 IF(AND(MM, MSK19).EQ.0) GO TO 250 6. DVIDV = (V*A*+OCORHO+COSGAM*SIMPSI)/VI 7 SNG1=V*SINGAM/VI                                        | PDBC<br>PDBC<br>PDBC<br>PDBC<br>PDBC                          | 250- |     |          |
| 8.                                                                                                                                                                                                | P08C<br>P08C<br>P08C<br>P08C<br>P08C<br>P08C<br>P08C          |      | 426 |          |
| 6. 250 IF(ANDIMM, MSK20).E0.0) 60 TO 260 7. VICI = VI* C561 8 TM0= - V* SINGAM/(VI* VICI) 9 DGIDV = SINGAM/VICI + IMQ*DVIQV                                                                       | FDBC<br>PDBC<br>FDBC<br>PDBC                                  | 260- |     | 1        |

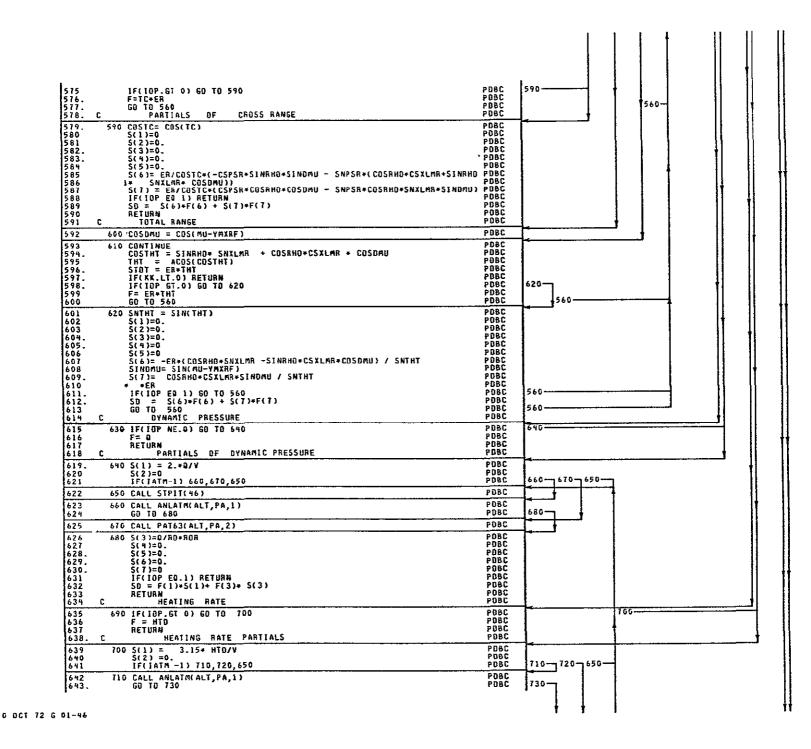
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| 654<br>655<br>656<br>657<br>658<br>659<br>660<br>661<br>662<br>663<br>664<br>665<br>666<br>667<br>669<br>670 | 720 CALL PATES(ALT,PA,2)  730 S(3) = 5 * HTD*RQE/RD  740 S(4) = 0 S(5) = 0. S(6) = 0. S(7) = 0. IF(10P.E0.1) RETURN SD = S(1)*F(1) + S(3)*F(3) RETURN C REYNOLDS NUMBER  750 RE = V/VNU IF(10P GT.0) GO TO 760 F RE RETURN C PARTIALS OF REYNOLS NUMBER  760 S(1) = 1./ VNU S(2) = 0. IF(16TM-1) 770,780,650  770 CALL ANLATM(ALT,PA,1) GO TO 790  780 CALL PATES(ALT,PA,2)  790 S(3) = - RE/VNU*VNR SO TO 740 C PAYLOAD WEIGHT  800 CALL WIDRP(SO(3,5)-W JORBURP, DW2,-1) CALL PAYLOO(FLOAD,DP2,SQ(4,1),SQ(3,5),W) IF(10P.GT.0) GO TO 81D F PLOAD RETURN C PAYLOAD PARTYALS | FB3C  FDBC   76G<br>7790<br>746<br>810 | |
|---|---|---|---|
| 671-<br>678-<br>679-<br>681-<br>682-<br>684-                                                                 | S(4)= GR*DP2 S(5)=0. S(6)=0 S(6)=0 S(7)=0 IF(10P.GT 1) SC = S(4)*F(4) RETURN END                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | JULY28 PDBC PDBC PDBC PDBC OS PDBC PDBC                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                           |

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# SUBRØUT I NE PDY3A

#### Subroutine PDY3A

# Entry PDY

#### Purpose

PDY or PDY3A combines and calculates complete partial derivatives of the equations of motion with respect to the state for the adjoint differential equation coefficients. PDY is called from MODEL (MODELB).

| FORTRAN<br>Symbol | MATH<br>Symbol | Cool | DESCRIPTION                                                  | S TO    | LOC     | <u>5 UARO I</u><br>S UAR                                                        |                           | USAGE<br>VAR                                                                           |
|-------------------|----------------|------|--------------------------------------------------------------|---------|---------|---------------------------------------------------------------------------------|---------------------------|----------------------------------------------------------------------------------------|
| 3111000           | 3141000        |      |                                                              | BEBOK   | 100     | 3054                                                                            | 0000                      |                                                                                        |
| AG                | a '            | 1    | Acceleration vector element.                                 | /AXL    | /( 2)   | ACCEL<br>DER3A<br>PDY3A                                                         | rs<br>l<br>l              | AG<br>AG                                                                               |
| AGM               |                | 1    | Element of matrix of acceleration vector partials WRT state. | /AXL    | /( 30)  | ACCEL<br>PDY3A                                                                  | 0<br>1                    | AGM<br>AGM                                                                             |
| AGR               |                | I    | Element of matrix of acceleration vector partials WRT state. | /AXL    | /( 18)  | ACCEL<br>PDY3A                                                                  | 0                         | A GR<br>A GR                                                                           |
| AGV               |                | 1    | Element of matrix of acceleration vector partials WRT state  | /AXL    | /( 6)   | ACCEL<br>PDY3A                                                                  | 0<br>1                    | AGV<br>AGV                                                                             |
| AMM               |                | I    | Element of matrix of acceleration vector partials WRT state. | /AXL    | /( 32)  | PDY3A                                                                           | I                         | AMM                                                                                    |
| AMR               |                | I    | Element of matrix of acceleration vector partials WRT state. | /AXL    | /( 20)  | ACCEL<br>PDY3A                                                                  | 8<br>1                    | AMR<br>AMR                                                                             |
| AMY               |                | I    | Element of matrix of acceleration vector partials WRT state. | /AXL    | /( 8)   | ACCEL<br>PDY3A                                                                  | 0<br>I                    | AMV<br>AMV                                                                             |
| AP                | a⁴             | I    | Acceleration vector element.                                 | /AXL    | /( 3)   | ACCEL<br>DER3A<br>PDY3A                                                         | M<br>I<br>I               | AP<br>AP<br>AP                                                                         |
| APM               |                | I    | Element of matrix of acceleration vector partials WRT state. | /AXL    | /( 31)  | ACCEL<br>PDY3A                                                                  | 0                         | APM<br>APM                                                                             |
| APR               |                | I    | Element of matrix of acceleration vector partials WAT state  | /AXL    | /( 19)  | ACCEL<br>PDY3A                                                                  | 0                         | APR<br>APR                                                                             |
| APV               |                | I    | Element of matrix of acceleration vector partials WRT state. | /AXL    | /( 7)   | ACCEL<br>PDY3A                                                                  | 0<br>1                    | APV<br>APV                                                                             |
| AVR               |                | I    | Element of matrix of acceleration vector partials WRT state. | /AXL    | /( 29)  | ACCEL<br>PDY3A                                                                  | 0<br>I                    | AVA<br>AVA                                                                             |
| AVR               |                | 1    | Element of matrix of acceleration vector partials WRT state. | /AXL    | /( 17)  | ACCEL<br>PDY3A                                                                  | Ü                         | AVR<br>AVR                                                                             |
| AVV               |                | 1    | Name of acceleration partials matrix.                        | /AXL    | /( 5)   | ACCEL<br>ACCEL<br>PDY3A                                                         | Р<br>О<br>I               | AVV<br>AV<br>AVV                                                                       |
| COSGAM            | cos(7)         | 1    | See symbol                                                   | /STATE3 | /( 687) | ACCEL<br>BL4<br>BL8<br>DER3A<br>EQUA3<br>MODEL<br>MODEL<br>OUT<br>PDBC<br>PDY3A | 0<br>A I<br>B I<br>I      | COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM<br>COSGAM           |
| COSPSI            | cοs(ψ)         | I    | See symbol                                                   | /STATE3 | /( 705) | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODEL<br>MODEL<br>PDBC<br>PDY3A          | B I                       | COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI<br>COSPSI |
| COSRHO            | cοs(ρ)         | I    | See symbol                                                   | /STATE3 | /( 707) | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODEL<br>MODEL<br>OUT<br>PDBC<br>PDY3A   | M<br>A I<br>B I<br>I<br>I | COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO<br>COSRHO |
| нава              |                | 1    | Partial of gravity wrt altitude                              | /GENF   | /( 563) | BL7<br>BL8<br>EQUA3<br>PDY3A                                                    |                           | GH<br>GH<br>DGOH                                                                       |

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| FORTRAN<br>Symbol | MATH<br>Symbol | COD | DESCRIPTIO                         | IN               | STORAS<br>BLUCK | SE<br>LOL | SUBROUTIN<br>SUBR COD                                                                            |                                                              |
|-------------------|----------------|-----|------------------------------------|------------------|-----------------|-----------|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
|                   | <del></del>    |     |                                    |                  |                 |           |                                                                                                  |                                                              |
| G                 | 9              | 1   | Gravitational attraction           | (FT/SEC++2)      | /GENF /(        | 301)      | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 M<br>MODELA I<br>MODELB I<br>PDY3A I<br>SDER3 M      | 0000000000                                                   |
| GDG               |                | 0   | Partial derivative of equation of  | motion WRT state | /STATE3/(       | 729)      | ADEQ3A I<br>PDY3A O                                                                              | 606<br>606                                                   |
| GDM               |                | 0   | Partial derivative of equation of  | motion WRT state | /STATE3/(       | 741)      | ADEO3A I<br>PDY3A O                                                                              | GDM<br>GDM                                                   |
| GDO               |                | 0   | Partial derivative of equation of  | motion WRT state | /STATE3/(       | 750)      | ADEQ3A I<br>PDY3A O                                                                              | GDO<br>GDO                                                   |
| GDP               |                | 0   | Partial derivative of equation of  | motion WRT state | /STATE3/(       | 745)      | ADEQ3A I<br>PDY3A 0                                                                              | GDP<br>GDP                                                   |
| GDPH              | a7/a¢          | 0   | See symbol                         |                  | /AEC03 /(       | 14)       | ACCEL O<br>ADEO3A I<br>PDY3A 0                                                                   | GOPH<br>GDPH<br>GDPH                                         |
| GDR               |                | 0   | Partial derivative of equation of  | motion WRT state | /STATE3/(       | 735)      | ADEQ3A I<br>PDY3A D                                                                              | GDR<br>GDR                                                   |
| GDV               |                | 0   | Partial derivative of equation of  | motion WRT state | /STATE3/(       | 722)      | ADEQ3A I<br>PDY3A D                                                                              | 6DV                                                          |
| TD                | è              | M   | Heating derivative                 |                  | /STATE3/(       | 22)       | DERSA O<br>OUT I<br>POBC I<br>PDYSA M                                                            | ДТН<br>ПТО<br>ПТН<br>ПТН                                     |
| HTDR              |                | 0   | Partial derivative of equation of  | wotion WRT state | /STATE3/(       | 754)      | ADERSA I<br>PDYSA D                                                                              | HT DR<br>HT DR                                               |
| łTDV              |                | 0   | Partial derivative of equation of  | motion WRT state | /STATE3/(       | 753)      | ADEQ3A I<br>PDY3A O                                                                              | HTDV<br>HTDV                                                 |
| JGII              |                | Ī   | Control option                     |                  | /XCODES/(       | 195)      | ACCEL I<br>BNTG O<br>DER3A I<br>FNTG M<br>GUI3A I<br>MODELA I<br>MODELA I<br>MODELB I<br>MOY3A I | JGII<br>JGII<br>JGII<br>JGII<br>JGII<br>JGII<br>JGII<br>JGII |
| JPRP              |                | I   | Propulsion flag for different rock | et options       | /XCODES/(       | 194)      | ACCEL I<br>DER3A I<br>EQUAS I<br>MODELA I<br>POY3A I<br>PROPB O<br>PROPIN O                      | JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP         |
| MDM               |                | 0   | Partial derivative of equation of  | motion WRT state | /STATE3/(       | 742)      | ADEQ3A I<br>PDY3A O                                                                              | MDM<br>MDM                                                   |
| 1DR               |                | G   | Partial derivative of equation of  | motson WRT state | /STATE3/(       | 736)      | ADEQ3A I<br>PDY3A O                                                                              | MDR<br>MDR                                                   |
| nD V              |                | 0   | Partial derivative of equation of  | motion WRT state | /STATE3/(       | 724)      | ADEQ3A I<br>PDY3A O                                                                              | MD V<br>MD V                                                 |
| ОСОЯНО            | ω×COSRHO       | I   | See symbol                         |                  | /STATE3/(       | 708)      | DER3A I<br>EQUA3 M<br>MODELA I<br>MODELB I<br>PDBC I<br>PDY3A I                                  | OCORI<br>OCORI<br>OCORI<br>OCORI<br>OCORI                    |

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| FORTRAN | MATH           | CODE  | DESCRIPTION                                                | STORAC    |      | SUBROUTINE                                                                                                         |                                                              |
|---------|----------------|-------|------------------------------------------------------------|-----------|------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| SYMHOL  | SYMBOL         |       | DESCRIPTION                                                | BLOCK     | LOC  | \$08m C008                                                                                                         | RAV                                                          |
| 000002  | w×0CORHO       | I See | symbol                                                     | /STATE3/( | 109) | DER3A I<br>EQUA3 O<br>MODELA I<br>MODELB I<br>POY3A [                                                              | 0C0R02<br>0C0R02<br>0C0R02<br>0C0R02<br>0C0R02               |
| 006     |                | 0 Par | tial derivative of equation of motion WRT state            | /STATE3/( | 732) | ADEQ3A I<br>POY3A O                                                                                                | 00G<br>00G                                                   |
| ODP     |                | 0 Par | tia! derivative of equation of motion WRT state            | /STATE3/( | 747) | ADED3A I<br>PDY3A D                                                                                                | 00P<br>00P                                                   |
| ODR     |                | 0 Par | tial derivative of equation of motion WRT state            | /STATE3/( | 738) | ADEQ3A I<br>PDY3A 0                                                                                                | ODR<br>ODR                                                   |
| ODV     |                | M Par | tial derivative of equation of aution WRT state            | /STATE3/( | 726) | ADED3A I<br>PDY3A M                                                                                                | 0DV -                                                        |
| 9 mG Z  | ω              | l Ear | th rotation rate (RAD/SEC)                                 | /GLOBAL/( | 3)   | ADID3A I<br>CRASH I<br>DER3A I<br>EQUAS I<br>GEINP I<br>MODELA I<br>POBC I<br>PDBC I<br>PDBC I<br>PDBC I<br>PDBC I | OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ |
| PDG     |                | 0 Par | trai derivative of equation of motion WRT state            | /STATE3/( | 731) | ADED3A I<br>PDY3A 0                                                                                                | PDS<br>PDS                                                   |
| PDM     |                | 0 Par | tial derivative of equation of motion WRT state            | /STATE3/( | 743) | ADEQ3A I<br>PDY3A 0                                                                                                | PDM<br>PDM                                                   |
| P00     |                | 0 Par | tial derivative of equation of motion WRT state            | /STATE3/( | 751) | ADEQ3A I<br>PDY3A O                                                                                                | PD0<br>PD0                                                   |
| PDP     |                | 0 Par | tial derivative of equation of motion WRT state            | /STATE3/( | 746) | ADEGSA I<br>PDYSA 0                                                                                                | POP<br>POP                                                   |
| PDPH    | ∂ <b>•</b> ⁄∂¢ | 0 See | symbol                                                     | /AEC03 /( | 15)  | ACCEL 0<br>ADEQ3A I<br>PDY3A 0                                                                                     | POPH<br>POPH<br>POPH                                         |
| PDR     |                | 0 Par | tral derivative of equation of motion MRT state            | /STATE3/( | 737) | ADEQ3A I<br>PDY3A 0                                                                                                | PDR<br>PDR                                                   |
| POV     |                | 0 Par | tial derivative of equation of wotion WRT state            | /STATE3/( | 725) | ADEQ3A I<br>PDY3A D                                                                                                | PBV                                                          |
| QMULT   | =0 OR 1        | I Hea | ting flag multiplier                                       | /ARCDAT/( | 40)  | DER3A I<br>FXBAT 0<br>PDY3A I                                                                                      | OMULT<br>OMULT<br>OMULT                                      |
| R       | R              | I Rad | ial distance from earth center to vehicle (FT)             | /GENF /(  | 305) | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 M<br>MODELA I<br>MODELB I<br>POBC I<br>POY3A I<br>TRTOSZ I             | A<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R<br>R          |
| ROG     |                | 0 Par | tial derivative of equation of motion WRT state            | /STATE3/( | 730) | ADEQ3A I<br>O AEVOQ                                                                                                | RDG<br>RDG                                                   |
| RDV     |                | û Par | tial derivative of equation of motion WRT state            | /STATE3/( | 723) | ADEQ3A I<br>PDY3A 0                                                                                                | RDV<br>RDV                                                   |
| RHOB    | Pb             | I Atm | osphere base density for heating calculation<br>(LB/FT**3) | /ARCDAT/( | 39)  | DER3A I<br>FXDAT 0<br>PDY3A I                                                                                      | RHOB<br>RHOB<br>RHOB                                         |

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                          | J              | SIORAGE<br>BLOCK LOC | SUBROUTINE USA<br>SUBR COOE VA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                               |
|-------------------|----------------|------|--------------------------------------|----------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| RO                | ρ.             | 1    | Atmospheric density                  | (SLUGS/FT++3)  | /GENF /( 309         | ) BL7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                               |
| ROR               |                | I    | Deriv Of density art alt.            |                | /GENF /( 313         | ) BL7 I ROR<br>BL8 I ROR<br>EQUAS I ROR<br>PDBC I ROR<br>PDY3A I ROR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                               |
| SINGAM            | sin( 7 )       | I    | See symbol                           |                | /STATE3/( 688        | BL4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | GAM<br>GAM<br>GAM<br>GAM<br>GAM<br>GAM<br>GAM |
| SINPSI            | \$ i n ( ∳ )   | I    | See symbol                           |                | /STATE3/( 704        | BL4 I SINP BL7 I SINP BL8 I SINP DER3A I SINP EQUA3 O SINP MODELA I SINP MODELB I SINP PDBC I SINP PDBC I SINP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | PSI<br>PSI<br>PSI<br>PSI<br>PSI<br>PSI        |
| SINRHO            | sin(ρ)         | I    | See symbol                           |                | /STATE3/( 706        | BL4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | RHO<br>RHO<br>RHO<br>RHO<br>RHO<br>RHO<br>RHO |
| SURT              |                | F    | Square root function                 |                | /SQRT /(\$           | NALATM F SORT CRASH F SORT OCTOE F SORT DERAGA F SORT MODELA F SORT MODELA F SORT PAYOZ F SORT PAYOZ F SORT POYSA F SORT STORE F SORT S |                                               |
| UDG               |                | 0    | Partial derivative of equation of mo | tion WRT state | /STATE3/( 73         | ) ADED3A I UDG<br>PDY3A O UDG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                               |
| UDO               |                | 0    | Partial derivative of equation of mo | tion WRT state | /STATE3/( 75         | ) ADEQ3A I UDO<br>PDY3A O UDO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                               |
| UDP               |                | 0    | Partial derivative of equation of mo | tion WRT state | /STATE3/( 748        | ) ADEQ3A I UDP<br>PDY3A O UDP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                               |
| UDR               |                | М    | Partial derivative of equation of mo | tion WRT state | /STATE3/( 739        | ) ADEQ3A I UDR<br>PDY3A M UDR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                               |
| UDV               |                | M    | Partial decivative of equation of wo | tion WRT state | /STATE3/( 727        | DV M AEVOR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                               |
| 30 OCT 72         | G.01-46        |      |                                      |                |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                               |

| FORTRAN | MATH   | CODE          | חבכרו         | RIPTI      | ∩ NI     |           | STORAC    |      |                                                                                                                                  |      | USAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------|--------|---------------|---------------|------------|----------|-----------|-----------|------|----------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL | 0000          | DESC          | NIFII      | UIV      |           | BLOCK     | LOC  | SUBA                                                                                                                             | CODE | VAR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| V       | •      | î Relative ve | locity        |            |          | (FT/SEC)  | /STATE3/( | 1)   | ACCEL ADICB3 ADICB3 ADICB3 ASI3 BL4 BL7 BL8 CON3 DEFF3 ENVPRM EQUA3 MODELA MODELA MODELA MODELA MODELA FEUSSA ENTRIASA STPB TOPM |      | V 4AR<br>V 4AR |
|         |        |               |               |            |          |           |           |      | YREF3                                                                                                                            | M    | ٧                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| ADB     |        | 0 Partial dec | Ivative of ed | quation of | motion t | JRT state | /STATE3/( | 728) | ADEQ3A<br>PDY3A                                                                                                                  |      | AD@                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| VDM     |        | O Partial des | ivative of eq | quation of | motion t | JRT state | /STATE3/( | 740) | ADEQ34<br>PDY3A                                                                                                                  |      | PIGV<br>PIGV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| ADG     |        | O Partial der | ivative of ea | quation of | motion b | NRT state | /STATE3/( | 749) | ABEQ3A<br>PDY3A                                                                                                                  |      | VDB<br>VDB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| VDP     |        | O Partial der | ivative of e  | quation of | motion i | URT state | /STATE3/( | 744) | AGEQ3A<br>PDY3A                                                                                                                  |      | VDP<br>VDP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| VDR     |        | O Partial der | ivative of e  | quation of | motion ( | ART state | /STATE3/( | 734) | ADEQ3A<br>PDY3A                                                                                                                  |      | VDR<br>VDR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| VDV     |        | 0 Partial dea | ivative of e  | quation of | motion L | JRT state | /STATE3/( | 721) | ADE03A                                                                                                                           | I    | VDV<br>VDV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

| . C | COMBINE AN                                | B CALCULATE                                              | PARTIALS           | FOR ADJOIN            | ts.                    | MM63<br>MM63  |
|-----|-------------------------------------------|----------------------------------------------------------|--------------------|-----------------------|------------------------|---------------|
| Č   | COMMON/ARCOAT/                            | D UNCOUCHTE                                              |                    | 1011 1153011          |                        | COAN<br>ARCDA |
|     | #SREE E1                                  | , XISP                                                   | ,TAULT             | DINC                  | ISTO                   | ARCOM         |
|     | # 1 A 1 B 1 B 1 B 1 B 1 B 1 B 1 B 1 B 1 B | LAFR                                                     | IPHII              |                       | MAAX                   | ARCDA         |
|     |                                           |                                                          | ALPHRI             |                       | .8959                  | , ARCDA       |
|     | おびひとは カカビじ                                | MAFN                                                     | PAEE               | MAEF                  | RAFE                   | , ARCDA       |
|     | 461 ATSP                                  | 4211                                                     | PL 23.16           | A LINE                | . 6908                 | , ARCDA       |
|     | #KIR YEGH                                 | . ZC6R                                                   | . XE               | 75                    | , XT                   | , ARCDA       |
|     | *DREF _MCNB                               | RHDB                                                     | ,OMULT             | REMAX                 |                        | ARCOA         |
|     | * FRATE ARCDI                             | 4)<br>(*B)                                               |                    |                       |                        | RETAR         |
| •   | EQUI VALENCE ( SREF                       | ARCHAI                                                   |                    |                       |                        | ARCD/         |
|     | COMMON/STATES/                            | ,                                                        |                    |                       |                        | STATE         |
|     | #VAR(14) .DVAR                            | (14). VARL (9                                            | 93 .OVARLC9        | 9) (40(9)             | ,549(10)<br>,544BP(15) | STATE         |
|     | *XL(9,9) YDP(2<br>*SINPSI ,COSPS          | (14), VARL (9<br>0,9), VDS (20,                          | 9).CO5648          | SINGAM                | .SAVBP(15)             | STATE         |
|     | *JINFJI , LUDES                           | 1 ,510KMC                                                | ,COSRHO            | , осояно              | CCCROZ                 | . 51415       |
|     | +5VBV (9) DHESA                           | , OMEGA2                                                 |                    | -                     | •                      | STATE         |
|     | *404 ,6D4                                 | RUA                                                      | , may              | , PDV                 | ,00¥                   | , STATE       |
| •   | -UDY ,VDG                                 | ,606                                                     |                    | ,P06                  | ,006                   | STATE         |
|     | +UDG VOR<br>+UDR VOM                      | , GDA                                                    | , MDR              | PDR                   | ,00R                   | STATE         |
|     | *UDR VOM<br>*GDP PDP                      | , SDM<br>, SDM<br>, ODP                                  | , HDM<br>, UDP     | , PDM<br>, VDB        | , VOP                  | STATE         |
| •   | *P00 ,U00                                 | ,HTDV                                                    | HTOR               | , 400                 | ,600                   | , STATE       |
|     | REAL HDM , MDV,                           | MAD , TILDY                                              | ,4100              |                       |                        | STATE         |
| •   | COMMON/STÁTES/                            | T.DIL                                                    |                    |                       |                        | STATE         |
|     | +SIN2RO .COS2R                            | 0 ,00526#                                                |                    |                       |                        | STATE         |
|     | COMMON/AFCO3/                             |                                                          |                    |                       |                        | AECO3         |
|     | *APHO ,APHR                               | , ALPHA                                                  | , VDA              | , SDA                 | ,PDA                   | , AECOS       |
|     | #SINA COSA                                | PHIN                                                     | PHIR               |                       |                        | , AECO3       |
| •   |                                           |                                                          | 110001             | ) IIAMP(Y)            | CDO                    | , AECO:       |
|     | *CDOM ,CLO                                | FK                                                       | , XCGM             | ZC60                  |                        | , AECO        |
|     | *CM CMA<br>≠CLAM CL                       |                                                          | AM ,CMO            | CMGM                  | FKM                    | , AECO        |
|     | -00 004                                   | ,CLA                                                     | ,CLM               | ,                     |                        | AECO3         |
| •   | COMMON/GENE/                              | , CDH                                                    |                    |                       |                        | AECO:<br>GENF |
|     | *0nG(20) _0mGP(                           | 20,2), VARQ(9)                                           | ,TOL(9)            | ,5 VAR(16)            | , MBC(20)              | CENE          |
|     | 14074 (P P 144                            | 9) / ', BCON(9)                                          | ,coticé,           | ๆ) ,็ก็รถี่พี่เจ้า    | DIP                    | CEME          |
|     | <b>#</b> 015 DT                           | i i                                                      | nesa               | a                     | as                     | CENE          |
| •   |                                           | RIGH                                                     | PA                 |                       | . 1.5                  | , SENF        |
|     |                                           |                                                          | 1759               | . VNH                 | 59850                  | , GENF        |
|     |                                           | H .11FES                                                 | - 105              | . 105                 |                        | , GENF        |
|     | #1511202 CPR                              | [24],015(24)                                             |                    |                       |                        | , GENF        |
|     |                                           | 1703 0161670                                             | 1 0151726          | ) IIME                |                        | , GENF        |
|     | RITHER FIFE                               | DRAG                                                     | . XAX              | IKNA                  | . 159(20)              | , GENF        |
|     |                                           | FP(1) (1)                                                | FP13               | MACHR                 | MACHY                  | , SENF        |
|     | ank na                                    | FVAC                                                     | LIFTY              | * 00.00               | 22405                  | SENF          |
| •   | *LIFTR LIFTA                              | ,DBR                                                     | DRAGV              | DRAGR                 | DRAGA<br>,ISPF         | , GENF        |
|     | + L1F1F                                   | ULFT                                                     | ,DB<br>,ULFTV      | , ISP<br>, ULFTR      | ULFTA                  | , SENF        |
|     | *XMCG,XMCGV                               | , XACGR                                                  | XHCGA              | XMCGM                 | CODAE                  | CEME          |
| •   | *CULFT ,CT                                | CALPHA                                                   | , CDE              | DELTAE                | ,510                   | CENE          |
|     | +COD SIDAE                                | ,xce                                                     | ,zce               | ,XJ                   | ,010                   | SENF          |
|     | COMMON / GENF /                           |                                                          | •                  |                       |                        | SENF          |
|     | *XIV XIR                                  | , SH                                                     | ,SAMMAD            | , XKG                 | ,XKP                   | . GENF        |
| •   | *FRATED BRATES                            |                                                          |                    |                       |                        | SENF          |
|     | EP1 97                                    |                                                          | , XK1              | ,XK2                  | , XK3                  | , GENF        |
| -   |                                           |                                                          | X B 1 3 E          | 1620                  | 18311                  | , GENF        |
|     | #XK1A . XKZA                              | , XK3A                                                   | XXIV               |                       | XXXX                   | , GENF        |
|     | *XK16 . XK26                              | , XK36                                                   | IKIP               | 1822                  | YK3P                   | , GENF        |
|     | PARIK ARZR                                | , XK3H                                                   | , 1510             | . 1820                | X K 3 i 1              | SENF          |
|     | ***************************************   | , xk30                                                   | ,XXIM              |                       | . 26.575               | SENF          |
| •   | DESI LICTO AT                             | ,XK3U<br>PP<br>FT LIFTA,LI<br>V,LIFTV IRA<br>0),TSTI(10) | , PR'              | , PO MACH,            | , DPDY(3,8)            | SENF          |
|     | * ISP. ISPF. MACH                         | V, LIFTY , IRA                                           | ten                | naus,                 | . OHURR                | FRAT          |
| •   | * ISP, ISPF, MACH<br>DIMENSION TPHICE     | O) TSTACION                                              | 120                |                       |                        | GENE          |
| •   | EQUI VALENCE (TLP)                        | TERRIT CTICL                                             | T5T13              |                       |                        | SENF          |
|     | COMMON /XCODES/                           | , , ,                                                    |                    |                       |                        | X CO DE       |
| :   | *1TQ (9),1COR                             | (20),ITI                                                 | ,INTB              | .3810(20              | 2), JFH (20,2          | )_ XC006      |
|     | #15T (26)                                 | NCNST                                                    |                    |                       |                        | , xcabe       |
| ,   |                                           | * * - *                                                  | TEAD               | TER                   |                        | * Y CO DO     |
|     | *120P ,1C0P                               | , I F R W                                                | , LP MA            | , 11 0                | ,                      | , ALCOU       |
| •   | *IZOP ,ICOP<br>*IOPEN ,IPH<br>*ITCT ,ITER | IFAW<br>ISPH<br>IVAR                                     | IFAR<br>ISST<br>JK | ,IFB<br>,IARC<br>,JPS | , ISTART<br>, JS       | , xcool       |

20 DCT 72 G 01-46

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XCODES
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XCODES
EEUV3
EEUV3
   *KOP , KPST , K , KST , NAD , NCASE , NCN , NCOB , NEOB , NEOB , NEO , NOP , NPH , N , NST , 1PST , 1PST , 1PST , 1PST , 1STN , 1PHN , 1STNB , 1PHNB , 1BLK1 , 1BLK2 , 1STOP , 1STPP , L , 1FOB , NB , LB , NB , NPHP , NPHB , NPHP , NPHB , NCTI , NCOF , 1LAG(8) , JPPP , JG1 , MT , MPIN(2O) , JP1 , JP2 , JP3 , EQUIVALENCE (VAR(1), V) , (VAR(2), GAM) , (VAR(3), ALI) , (VAR(4), M) , (VAR(5), PSI) , (VAR(6), HD) , (VAR(7), MD) , (VAR(6), HD) , (VAR(6), ND) , (DVAR(7), UD) , (DVAR(6), ND) , (DVAR(7), ND) , (DVAR(7), ND) , (DVAR(6), ND) , (DVAR(6), ND) , (DVAR(7), ND) , (DVAR(
   ,KPST
,NEOB
,1PST
,1BLK1
   ,KST
,NOP
,ISTN
,ISTOP
   , NAD
, NPH
, IPHN
, ISTPP
    7777888888888889999999999012345
   *KOP
  NCASE
   E0043
E0043
   REAL M, NO, MO
COMMON/Data/
PI RAD RDI SC UM
FINM CAR JOP1 JOP2 JO
COMMON/GLOBAL/
SER JER JOP2 JOP2
SER JER JOP2 JOP2
SER JER JOP2 JOP2
SER JER JOP2 JOP2
SER JER JOP4
SER J
  DATA
DATA
DATA
GLOBAL
GLOBAL
   ,TMPF
,JOP4
   ,LUA
,IO(4)
   , MBRAN , NFARC , ID(4)
, MAXTAB IPFLG2, IPFLG3, IPFLG4, INEQFL(20)
   GLOBAL
GLOBAL
GLOBAL
   RETAP
   AXL
AXL
AXL
AXL
PO114
POMB
COMM
COMM
COMM
COMM
COMM
COMM
   E
II CALC.
  ACCELERATION VECTOR AND MATRIX OF PARTIALS
  Ç
   III GRIND OUT PARTIAL DERIVATIVES

VSQ = V* V

VDV= AVV

ROSQ = A* DCDRO2

VD6= ROSQ* ( COSRHO*COSGAM+SINRHO*COSPSI*SINGAM) -G*COSGAM

VDP= ROSQ* SINRHO* SINPSI*COSGAM

VDR= OCORO2*(COSRHO*SINGAM- SINRHO*COSPSI*COSGAM) - DGDH*SINGAM+AV

R
   PDY3B
   PDY3B
PDY3B
   PDY3B
   VDR= OCORO2*(COSRHD*S)NGAM- SINKHU*COSPSI*COSGAM+ SINKHO*SINR PDY38
VD0= RDSQ *( -2.*SINKHO*SINGAM- COSRHO*COSPSI*COSGAM+ SINKHO*SINR PDY38
HHO*COSPSI* COSGAM/COSRHO)
PDY38
VDR= AVM
IF(JGII EQ 8) 6D TO 9
6DV= COSGAM*(1./R+ 6/VSQ) - ROSQ/VSQ*(COSRHO*COSGAM*SINKHO*COSPSI PDY38
1*SINGAM)*AGV/V-AG/VSQ
FDY38
FDY38
GDG= SINGAM*(G/V-V/R) + ROSQ/V*( SINKHO*COSPSI*COSGAM- COSRHO*S PDY38
11NGAM)
  GDE= SINDAM*(GVY-VK) + NOSGVY*(SINRHO*COSPSI*COSGAM-

INGAM)

GDP= 2.*OMGZ*COSRHO*COSPSI- ROSQ/Y*SINRHO*SINPSI*SINGAM

GDR= COSGAM*(-V/(R*R)-DGDH/V) +OCOROZ/V*(COSRHO*COSGAM+ SINRHO

1*COSPSI*SINGAM) + AGR/V

GOD= -2 *OMGZ*SINRHO*SINPSI+ ROSQ/V*(-2.*SINRHO*COSGAM+ COSPSI*

SINGAM*(COSRHO-SINRHO*SINRHO*COSRHO))

GOM= AGR/V

GE(ASSINGSGAM) IT 1 E-11) GO TO 10
   PDY3B
PDY3B
  SINRHD
   PRYSE
   PDY3B
   POY3B
   PDY3B
PDY3B
PDY3B
   POY3B
PO14
POY3B
   POY3B
   PDY3B
   MAR14
PDY38
PDY38
PDY38
   PDY3B
PDY3B
   PDY38
PDY3B
   PDY3B
PDY3B
COMN
   60 TO 20
   ε
```

10-

20-

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```
151.
   I۷
  PARTIALS ON VERTICAL RISE
  COMM
152.
153.
154.
155.
156.
157.
  9 GBV=0.
60G=0.
6DP=0.
60R=0.
8D0=0.
60A=0.
  P014
P014
P014
P014
P014
P014
158.
159.
160.
161.
162.
163.
                                      1G POV=0.
PDG=0.
PDR=0.
PCM=0.
PDP=0.
POO=0.
   P0Y38
P0Y38
P0Y38
P0Y38
P0Y38
P0Y38
                                    POD=0.

20 CONTINUE
ROV= SINGAM
RDG= V*COSGAM= COSPSI/R
DOS= -V*SINGAM=COSPSI/R
DDF=-V*COSGAM=SINPSI/R
DDF=-V*CDSGAM=SINPSI/R
CLAM = R*COSRHO
UDV= COSGAM= SINPSI/RCLAM
UDV= -V*SINGAM= COSPSI/ RCLAM
UDP= -V*COSGAM=COSPSI/ RCLAM
UDP= -V*UDV/R
UDD= -UDR*SINRHO*R/ COSRHO
HDDF=AMR
HDDF=AMR
HDDF=AMR
HDV=AMV
IF(OMULT*RO.NE.O.) GO TO 30
HTOV=0.
HTOR=0.
30 CONTINUE
164-
165-
166-
167-
170-
171-
173-
175-
175-
176-
177-
180-
181-
183-
  PDY3B
   PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
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PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
PDY3B
   36
  40-
184.
185.
186.
187.
                                      30 CONTINUE
HTD= #MULT+ 17600_*SQRT(RO/RHOB)*(Y/26000_)**3_15
HTDY= 3 15 *HTD/Y
HTDR= _5 * HTD*ROR/ RO.
  PDY3B
PDY3B
PDY3B
  POY38
188.
189.
190.
191.
192.
193.
194.
  POY3B
CGMN
COMN
POY3B
PDY3B
POY3B
POY3B
PDY3B
  40 CONTINUE
                         C
                                      V ZERO BANK ANGLE COMSIDERATION
50 IF(JGII.NE.12) RETURN
GOPH=G.
POPH=G.
RETURN
END
```

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# SUBRØUT I NE PRMSET

#### Subroutine PRMSET

### Purpose

PRMSET sets up nominal values of adjustable parameters for next iteration or solution trajectory.

# Description

PRMSET is called from TEST.

| FORTRAN<br>Symbol | MATH<br>Symbol     | CODE DESCRIPTIO                               | N STORAGE BLOCK LOC         | SUBROUTINE USAGE<br>SUBR CODE VAR                                                                                          |
|-------------------|--------------------|-----------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------|
| 1 COR             |                    | 1 Phase sequence array                        | /XCQDES/( 10                | ADJUST I ICOR<br>FNTG I ICOR<br>PRMSET I ICOR<br>SOINP M ICOR                                                              |
| IPOINT            |                    | I Code for each adjustable parameter descent. | in steepest /PARAM /( i     | ) ADJUST I IPOINT PRMSET I IPOINT SOINP O IPOINT STAU I IPOINT TOPM D IPOINT                                               |
| NPARA             |                    | i Number of adjustable parameters in problem. | trajectory /PARAM /( 13     | DADJUST I NPARA BNIG I NPARA FNIG I NPARA MTX3A I NPARA PAWD2 I NPARA SDINP M NPARA STAU I NPARA TEST I NPARA TOPM D NPARA |
| NPH               |                    | I Number of phases in trajectory              | /XCQDES/( 164               | ) BNTG I NPH<br>FNTG O NPH<br>PRMSET I NPH<br>SDINP M NPH<br>TEST I NPH<br>TOPM I NPH                                      |
| OMG               | Ω                  | M Array of arc cut off values [sd]            | /GENF /( 1                  | ) ADJUST M OMS<br>FNTG I OMG<br>PRMSET M OMG<br>PROPB I OMG<br>SDINP M OMG<br>STP3 I OMG<br>TOPM D IOMG                    |
| OMGP              |                    | O Array of phase cut off values Esd3          | /GENF /( 21                 | ) ADJUST 0 0MGP<br>FNTG M 0MGP<br>PRMSET 0 0MGP<br>SDINP M 0MGP                                                            |
| PARA              | р                  | M Adjustable parameter nominal value:         | . /PARAM /( 252             | ) ADJUST I PARA<br>PRMSET M PARA<br>TOPM D PARA                                                                            |
| SVAR              | y   <sub>t=0</sub> | A Array of state values at initial pr         | oblem time [sd] /GENF /( 79 | DADJUST O SVAR BNTG I SVAR FNTG I SVAR PRMSET M SVAR REU3 I SVAR TEST I SVAR TOPM I SVAR TRTOSZ I SVAR                     |

PRASET

```
SUBROUTINE PRMSET(II)
  PRASET
  123456789
  00000
  COMM
COMM
COMM
COMM
COMM
   SETS UP NOMINAL VALUES OF PARAMETERS FOR NEXT ITERATION
  TITERATION

DEPENDS ON WHETHER LAST TRAIL TRAJECTORY
SERVES AS NEW NORMAL (11=0) OR PREVIOUS
NOMINAL WILL BE SOLUTION TRAJECTORY (11 GT G )
COMMON/STATE3/
*VAR(14) DVAR (14) VARL (99) DVARL(99) Y0(9)
*XL(9,9) Y0F(20,9) Y0S (20,9) COSGAM SINGAM SA
*SINPSI COSPSI SINANG COSRHO COCRHO  COMM
COMM
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
  ,SVY(10)
,SAVBP(15)
,OCORO2
  10.
11.
12.
13.
14
15.
16.
17.
   004
206
206
207
207
800
  *FDO ,UDO
REAL MOM ,MDV ,MDR
COMMON/STATE3/
*SINZRO ,COSZRO
COMMON/GENF/
*OMG(20)
  STATE 3D
  STATESO
STATESO
STATESO
  20.22.23.24.25.27.
   ,C0526#
  OUSZEM , CUSZEM NF/ CU
  SENE
   WBC(26)
DTP
OS
CS
SUMSO
TR(9)
W
OMP
TBU(20)
   *OMG(20)
*A(9,9)
*DTS
*R
   *R
*VNU
*SVSQ
*TST(20)
*TLP1(20)
  289012334567
   *TIMPR
*AE
*BR
   LIFTY
DRASY
OB
ULFTY
XMCGA
CDE
,ZCG
  ORAGR
ISP
ULFTR
XMCGM
DELTAE
   DRASA
ISPF
ULFTA
CODAE
,SID
   *LIFTR
   DBR
ULFT
XMCGR
CALPHA
XCG
  GENF
GENF
GENF
  33444444444445555555555566666666661177777
   ,GAMMAD
  GENF
GENF
GENF
GENF
GENF
  , XKG
   , XKP
   XK1
XK1B
XK1V
XK1P
XK1O
XK1A
PR
  , XK2
, XK20
, XK27
, XK2P
, XK20
, XK25
, PO
  XK3B
XK3B
XK3V
XK3P
XK30
XK3A
  SEMF
SEMF
SEMF
SEMF
SEMF
SEMF
SEMF
FRAT
GEMF
F
  SENE
  ,OPBY(3,8)
  GENF
GENF
FRAT
   ¢
  36
   C
  PRASET 16-
20 OCT 72 6 01-46
```

|     |                                      |        |                                                                                                                                             | ·                                                                  |     |
|-----|--------------------------------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-----|
|     | 76.<br>77.<br>78.<br>79.<br>80.      | C      | KK= IPOINT(I)  ARC TIME PARA(I)= DM8(KK) SO TO 20                                                                                           | PRMSET<br>COMM<br>COMM<br>PRMSET<br>PRASET                         | 26- |
|     | 81.<br>82.<br>83.<br>84.             | C<br>C | UKK = IPDINI(I)- ZI  INITIAL STATE PARA(I) = SYARIKK+1)                                                                                     | PROSET<br>COMN<br>COMN<br>PROSET                                   |     |
| L)  | 85.<br>86<br>87                      | c      | O CONTINUE<br>RETURN<br>1B ERROR IN CONVERGNCE                                                                                              | PRASET<br>PRASET<br>PRASET                                         |     |
|     | 88<br>89.<br>90<br>91.<br>92.<br>93. | 3      | G DD 60 I=1,NPARA IF(1PGINT(1).6T.21) 60 TO 50 KK= IPBINT(1) OMG(KK)= PARA(1) DD 40 JJ=1,NPH IF(1COR(JJ).NE.KK) 60 TO 40 OMGP(JJ,2)=PARA(1) | PRASET<br>PRASET<br>PRASET<br>PRASET<br>PRASET<br>PRASET<br>PRASET | 40- |
| 15  | 95.<br>96.                           | 4      | G CONTINUE<br>GO TO 60                                                                                                                      | PRMSET<br>PRMSET                                                   | 60- |
|     | 97.<br>98                            |        | G KK= [PQINT(I)-21<br>SVAR(KK+1) = PARA(I)                                                                                                  | PRASET<br>PRASET                                                   |     |
| 1,1 | 99.                                  | U      | G CONTINUE RETURN END                                                                                                                       | PRMSET<br>PRMSET<br>PRMSET                                         |     |

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# SUBRØUT I NE PRØPB

#### Subroutine PROPB

### Purpose

Subroutine performs arc initialization for adjoint solution.

### Description

PRØPB is called from BNTG.

| FORTRAN<br>Symbol | MATH<br>Symbol   | CODE | DESCRIPTION                                |                    | STORA:<br>BLOCK | GE<br>LOC | SUBBOUTION SUBBOUTION                                                                                                  |                                                              |
|-------------------|------------------|------|--------------------------------------------|--------------------|-----------------|-----------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| 310000            | STREET           |      |                                            | <del></del>        | BLUCK           | LUC       | 300h C01                                                                                                               | JE TAN                                                       |
| AE                | Aexit            | 0    | Total nozzle exit area                     |                    | /GENF /(        | 520)      | ACCEL I<br>FH2 I<br>IMPUL I<br>PROPB O<br>PROPIN O<br>SOER3 I                                                          | AE<br>AE<br>AE<br>AE<br>AE                                   |
| AEZRO             | ∝old             | 0    | Angle of attack from last nominal trajecto | ry (DEG)           | /AEC03 /(       | 1)        | AST3 M<br>FNTG I<br>MTX3A I<br>OUT I<br>PROPB O<br>PROPIN D                                                            | APHO<br>APHO<br>APHO<br>APHO<br>AEZRO<br>AEZRO               |
| CDE               |                  | 0    | Constant value of engine deflection        | (RAD)              | /GENF /(        | 553)      | EL1 I<br>PROPB O<br>PROPIN O                                                                                           | CDE<br>CDE                                                   |
| DRAG              | D                | 0    | Aerodynamic drag                           | (LBS)              | /GENF /(        | 497)      | ACCEL I<br>BL5 I<br>BL7 I<br>BL8 I<br>ENVPRM I<br>FH3 I<br>OUT I<br>PROPB O<br>PROPIN O<br>PROPIN O<br>SCER3 I<br>VT M | DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG |
| EJ                | Aexit            | I    | Nozzle exit area                           | (FT <sup>2</sup> ) | /ARCDAT/(       | 2)        | PROPB I<br>PROPIN I<br>SIZIN O                                                                                         | EJ<br>EJ                                                     |
| FRATE             |                  | I    | Input rated vacuum thrust per engine       | (LBS)              | /ARCDAT/(       | 42)       | EQUAS I<br>FXDAT I<br>PROPB I<br>PROPIN I<br>SIZIN O                                                                   | FRATE<br>FRATE<br>FRATE<br>FRATE<br>FRATE                    |
| FRATED            |                  | 0    | Net rated maximum rocket vacuum thrust     | (LBS)              | /GENF /(        | 567)      | IMPUL I<br>PROPB O<br>PROPIN O                                                                                         | FRATED<br>FRATED<br>FRATED                                   |
| F VAC             |                  | M    | Total vacuum thrust [rocket]               | (LBS)              | /GENF /(        | 528)      | ACCEL I EQUAS M FH2 I IMPUL M PROPB M PROPIN M SDERS I                                                                 | FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC                 |
| GAMMAD            |                  | 0    | Pitch rate                                 | (RAD)              | /GENF /(        | 564)      | BL4 I<br>PROPB D<br>PROPIN O                                                                                           | GAMMAD<br>GAMMAD<br>GAMMAD                                   |
| GMAX              | G <sub>max</sub> | Ī    | Maximum total acceleration gload           |                    | /ARCDAT/(       | 12)       | BL5 I<br>FH3 I<br>MODELA I<br>PROPB I<br>PROPIN I                                                                      | GMAX<br>GMAX<br>GMAX<br>GMAX<br>GMAX                         |
| GMD0T             | 7*               | J    | Pitch rate                                 | (DEG/SEC)          | /ARCDAT/(       | 15)       | DER3A I<br>MODELA I<br>MODELB I<br>PROPB I<br>PROPIN I                                                                 | GMDOT<br>GMDOT<br>GMDOT<br>GMDOT<br>GMDOT                    |
| нрмах             | Q <sub>max</sub> | I    | Maximum heating rate inequality constraint |                    | /ARCDAT/(       | 14)       | PROPB 1                                                                                                                | HDMAX                                                        |

| FORTHAN<br>Symbol | MAIH<br>Symbol | CODE | DESCRIPTION                                                                                                                                                             |       | STORA<br>BLOCK | LOC LOC | SUBROUTINE<br>SUBR CODE                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------|----------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------|---------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IARC              |                | ſ    | Arc number                                                                                                                                                              |       | /xcodes/(      | 146)    | ENVPRM I<br>FNTG M<br>GETIT I<br>MODELA I<br>PROPB I<br>PROPIN I<br>REU3 I<br>SDINP M<br>STAU I<br>STP3 I | I ARCC I |
| INEOFL            |                | I    | A 20 mord array that contains the code number<br>the state variables inequality constraint tha<br>applies on each subarc. A zero entry indicat<br>that no SVIC applies. | t     | /GLOBAL/(      | 73)     |                                                                                                           | INEQF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| JAER              |                | I    | Aerodynamic model option flag                                                                                                                                           |       | /ARCDAT/(      | 9)      | BEROCO I<br>EQUAS I<br>GEINP I<br>OUT I<br>PROPB I<br>PROPIN I<br>VT I                                    | JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| JPRO              |                | ī    | Propulsion model option flag                                                                                                                                            |       | /ARCDAT/(      | 10)     | EQUAS I<br>GEINP I<br>IMPUL I<br>MODELA I<br>PROPB I<br>PROPIN I                                          | JPRO<br>JPRO<br>JPRO<br>JPRO<br>JPRO<br>JPRO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| JPRP              |                | Đ    | Propulsion flag for different rocket options                                                                                                                            |       | /XCOĐES/(      | 194)    | ACCEL I DERSA I EDUAS I MODELA I PDYSA I PROPB O PROPIN O                                                 | JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| JP1               |                | 0    | Option flag for first governing equation                                                                                                                                |       | /XCODES/(      | 217)    | AGETB3 M<br>AST3 M<br>MODELA M<br>MODELB I<br>PROPB O<br>PROPIN D                                         | JP1<br>JP1<br>JP1<br>JP1<br>JP1<br>JP1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| JP2               |                | 0    | Option flag for second governing equation                                                                                                                               |       | /XCODES/(      | 218)    | MODELA I<br>MODELB I<br>PROPB O<br>PROPIN O                                                               | JP2<br>JP2<br>JP2<br>JP2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| JS                |                | I    | Absolute value of arc cut-off option code                                                                                                                               |       | /xcobes/(      | 153)    | ADICB3 M<br>ADIC3A I<br>ADID3A I<br>BNTG M<br>FNTG M<br>PROPB M<br>PROPIN I<br>STP3 I<br>TOL3 I           | 15<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| LIFT              | L              | O    | Aerodynamic lift                                                                                                                                                        | (LBS) | /GENF /(       | 496)    | ACCEL I BL4 I BL5 I BL6 I ENVPRM I FH3 I OUT I PROPB D PROPIN D                                           | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| ORTRAN<br>Symbol | MATH<br>Symbol        | CODE DESCRIPTION                                                  | STORA<br>Block                | GE<br>LOC | SUBROUTINE<br>SUBR CODE                                                                                                                                                 |                                                                         |
|------------------|-----------------------|-------------------------------------------------------------------|-------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 3111801          | 314000                | 52001121 12011                                                    | BLUCK                         | 100       | 300K C00E                                                                                                                                                               |                                                                         |
| MAEA             |                       | I Curve number                                                    | /ARCDAT/(                     | 18)       | EQUA3 I<br>GEINP I<br>PROPB I<br>PROPIN I                                                                                                                               | MAEA<br>MAEA<br>MAEA<br>MAEA                                            |
| MISP             |                       | I Curve number kISP loss table                                    | /ARCDAT/(                     | 26)       | IMPUL I<br>PROPB I<br>PROPIN I                                                                                                                                          | MISP<br>MISP<br>MISP                                                    |
| MPIN             |                       | I Save thrust curve numbers for adjoint                           | solution /XCODES/C            | 197)      | PROPB I<br>PROPIN O                                                                                                                                                     | MPIN<br>MPIN                                                            |
| MT               |                       | I Curve number -thrust table                                      | /ARCDAT/(                     | 25)       | FXDAT I<br>PROPB I<br>PROPIN I<br>THRUST I                                                                                                                              | MT<br>MT<br>MT                                                          |
| MTT              |                       | M Thrust curve number                                             | /XCODES/(                     | 196)      | EQUA3 I<br>PROPB M<br>PROPIN M                                                                                                                                          | TIN<br>TIN<br>TIN                                                       |
| NST              |                       | I Number of arcs in trajectory                                    | /xcodes/(                     | 166)      | BNTG I<br>FNTG O<br>PROPB I<br>SDINP I<br>SDINP M<br>TEST I<br>TOPM I<br>TRAN3 I                                                                                        | NST<br>NST<br>NST<br>NST<br>NST<br>NST                                  |
| 0M6              | $\Omega_{\mathbf{j}}$ | I Array of arc cut off values [sd]                                | /GENF /(                      | 1)        | ADJUST M<br>FNTG I<br>PRMSET M<br>PROPB I<br>SDINP M<br>STP3 I<br>TOPM D                                                                                                | OMG<br>OMG<br>OMG<br>OMG<br>OMG<br>OMG                                  |
| QMAX             | x <sub>Am</sub> P     | I Maximum dynamic pressure instantaneous<br>limit                 | inequality /ARCDAT/(<br>(PSF) | 11)       | PROPB I                                                                                                                                                                 | XARS                                                                    |
| RDI              |                       | I Angle to radian conversion, .017453292                          | .52 /DATA /(                  | 3)        | BLICO I<br>DER3A I<br>FNTG I<br>GUI3A I<br>MODELA I<br>MODELB I<br>PAOSI D<br>PROPB I<br>PROPIN I<br>REU3 I<br>SOMG I                                                   | ADI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>R |
| REMAX            | R <sub>eymax</sub>    | I Maximum unit reynolds number inequalit                          | ty constraint /ARCDAT/(       | 41)       | PROPB 1                                                                                                                                                                 | REMAX                                                                   |
| T                | T                     | 0 Thrust                                                          | (LBS) /GENF /(                | 411)      | ACCEL I<br>BLGCON M<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>EQUAS O<br>FH1 I<br>FH2 I<br>FH3 I<br>FH4 I<br>IMPUL I<br>OUT I<br>PROPEN O<br>PROPIN O<br>REUS O<br>SDERS I | † † † † † † † † † † † † † † † † † † †                                   |
| TBU<br>30 DCT 72 | G.01-46               | I Saved rocket burn initiation times use adjoint integration (sd) | ed during /GENF /(            | 500)      | PROPEN O                                                                                                                                                                | TBU<br>TBU                                                              |

| FORTBAN<br>SYMBOL | MATH<br>Symbol    | CODE                       | DESCRIPTION                          | STI<br>BLOUK | ) R A ( | ξ<br>LOL | <u> </u>                                   |                       | E VAR                                     |
|-------------------|-------------------|----------------------------|--------------------------------------|--------------|---------|----------|--------------------------------------------|-----------------------|-------------------------------------------|
| TBURN             | t <sub>b</sub>    | O Rocket bur<br>trajectory | n initiation time on forward<br>Esd) | /GENF        | /1      | 499)     | EQUA3<br>MODELA<br>PROPB<br>PROPIN         | Ö                     | TBURN<br>TBURN<br>TBURN<br>TBURN          |
| T MULT            | T <sub>wult</sub> | I Thrust mul               | tiplier or number of engines         | /ARCDA       | r/(     | 4)       | EQUA3<br>FXDAT<br>PROPB<br>PROPIN<br>SIZIN | I<br>M<br>I<br>I<br>I | TMULT<br>TMULT<br>TMULT<br>TMULT<br>TMULT |
| ZERO              |                   | O Partial of               | mach number ært altitude             | /GENF        | /(      | 524)     | EQUA3<br>PROPB<br>PROPIN<br>VT             | 0<br>0<br>1. 0<br>1   | MACHR<br>ZERO<br>ZERO<br>MACHR            |

| 1.<br>2. C<br>3. C<br>4 C | PERF:              |                                             | UTTT6: 174T              |                  | DT 60.021        |                         | COMN         |
|---------------------------|--------------------|---------------------------------------------|--------------------------|------------------|------------------|-------------------------|--------------|
| 4 C                       | . =                |                                             | MITTALIZAT]              | IOW FOR ADJOI    | NT SOLUTIO       | J.R                     | COMM         |
| 5<br>6.                   | COMMON/<br>*APHO   | AECO3/                                      | AL BUA                   | WA.              | ***              | 204                     | AECO         |
| ?.                        | +SINA              | , APHR<br>, COSA                            | , ALPHA<br>, PHIO        | , VOA<br>, PHID  | , GDA<br>, PHI   | ,POA<br>,SINPHI<br>,CDG | , AECO       |
| 8                         | +COSPHI            | . BUPH                                      | PHPR                     |                  | _ XI ARP( 9 )    | ÉDG                     | AECO         |
| 9                         | *CDOM              | . 17.1.13                                   | FK                       | XCGM             | _ ZC6M           |                         | AECO         |
| 0.                        | *CM                | 1:054                                       | . CHAR . CI              | จก เทย           | CHOM             | ,FKM                    | , AECO       |
| 1 -<br>2                  | ≠CLAM              | ,CL                                         | CLA<br>CDA               | , CLM            | ,                |                         | AECO         |
| 2<br>3.                   | *CB                | CDA<br>CNCE (ADAG A                         | CDA<br>CZÓD V            |                  |                  |                         | AECO<br>APR2 |
| 4                         | DIMENSI            | ENCÉ (APHO,A<br>OH AEZRO(1)                 | ELNUJ                    |                  |                  |                         | APR2         |
| 5.                        | COMMON             | /XCODES/                                    |                          |                  |                  |                         | XCDD         |
| 6.                        | *ITQ               | (9),ICÓR (2                                 | 0),171                   | ,INTB            | ,JG18(20,        | 2),JPH (20,2            | ), XCÓB      |
| 7.<br>8                   |                    | 20)                                         | NENST                    |                  | NSAB             | ,NICNB                  | , xcop       |
| 9                         | +120P<br>+10PEN    | ,ICOP<br>,IPH                               | IFAU                     | , IFAR           | ,IFB             | IND<br>ISTART           | XCOD         |
| ó.                        | *ITCT              | ,ÎTER                                       | , ISPH<br>, I VAR        | ,ISST<br>,JK     | ,IARC<br>,JPS    | ,15 tant                | XCOD         |
| 1.                        | #KDP               | . KPST                                      | E.                       |                  | , WAD            | MILANE                  | * venn       |
| 2.                        | *#CN               | . NEOR                                      | . ME.U                   | - RUP            | _ NPH            | 44                      | . XC00       |
| 3                         | =NST               | LIPST                                       | IPRINT                   | 1514             | TPHM             | , ISTNB                 | , xcob       |
| 4<br>5                    | *IPHNB             | . 181 6 1                                   | , IBLKZ                  | , ISTOP          | ,ISTPP           | , L                     | XCOD         |
| 6                         | ≠TFOB<br>≠NCTIN    | , NB                                        | AD ES IEDO               | LOTE MET MOT     | .MPRP            | , MPNB                  | , XCOD       |
| 7                         | COMMONA            | GENÉ/                                       | HBCG1, JERF,             | .JGİI,MTT,NPI    | MC 201, JP1,     | 182,383                 | X COD        |
| B.                        | +0MG(20)           | .DMGP(20.                                   | 2).VARD(9)               | ,TOL(9)          | ,SVAR(10)        | , MDC( 26 )             | CENE         |
| 9.                        | #A(9,9)            | , ACON( 9)                                  | 2), VARQ(9)<br>, BCON(9) | 1381114 4 3      | . 131.1196 9 1   | nte                     | BENF         |
| 0.                        | *DT5               |                                             | . 6                      | NPSD             | . 2              |                         | GENE         |
| 1.                        | #R<br>####         |                                             |                          |                  | - NU             |                         | , GENF       |
| 2.<br>3                   | *¥NU<br>*5V5Q      | ,PAR<br>,TIMEPH                             | ROR<br>TIMES             | ESR              | , VHR            |                         | , SENF       |
| 4                         | *TST(20)           | TPH (2                                      | 0), DIS(20)              | ,TOP<br>,DIP(20) | , TOS            | ,TR(9)                  | GENF         |
| 5                         | +TLP1(20           | ) 1151 (2                                   | 01 BIP1(70)              | 1 8151(26)       | ,TIME            | 1100                    | CEME         |
| 6                         | *TIMP8             | LIFT                                        | DRAS                     | IDI              | .TBURN           | - 160(20)               | , SENF       |
| 7                         | ≠AE                |                                             | EPNIN                    | .FPA             | MACHR            | , MACHV                 | GENF         |
| 8                         | +0R                | .QV                                         | FVAC                     | ,LIFTY           | _                |                         | SENF         |
| 9                         | +LIFTR<br>≠        | ,LIFTA<br>LIFTM                             |                          | DHURA            | DRAGR            | , ISPF                  | , BENF       |
| ì                         | :                  | TIL 18                                      | , DBR<br>ULFT            | ,DB<br>,ULFTV    | , ISP            | , ULFTA                 | GENF         |
| Ž                         | *XMCG              | , XMCGV                                     | XMCCB                    | XACGA            | ,ULFTR<br>,XMCGM | CODAE                   | CENE         |
| 3.                        | +CULFT             | CT                                          | , CALPHA                 | , CDE            | DELTAE           | SID                     | CENE         |
| 4.                        | <b>≠</b> C80       | ,CT<br>,SIDAE                               | XCS                      | ,žč6             | ,XJ              | ,                       | GENF         |
| 5.                        | сонион .           | / SENF /                                    |                          |                  |                  |                         | GENF         |
| 6.<br>7.                  | #XJV               | , XJR<br>, IRATED                           | , SH                     | ,GAMMAD          | , XKG            | , XKP                   | , GENF       |
| 8                         | ≠FRATED<br>*P1     | , P2                                        | .P3                      |                  | ~~~              | ~~~                     | GENE         |
| ğ.                        | ≠XK1T              | ,XK2T                                       | ,XX3T                    | , XK1<br>, XK1B  | , XK2<br>, XK2D  | , XK3<br>, XK3D         | , GENF       |
| Ò                         | *XK1A              | XK24                                        | XXXX                     |                  | ,XKZV            |                         | , SENF       |
| 1                         | *XK16              | IKOG                                        | XXXX                     | IKIP             | . XX2P           | XX3P                    | SENF         |
| 2                         | ≠XK1R              | . XK2R                                      | XXXX                     | IKIN             | . XX28           | 3830                    | , GENF       |
| 3                         | *XK1U              | , XKZU                                      |                          | ,XK1M            | . X & Z PI       | ,XK3M                   | , SENF       |
| 4.<br>5                   | ≠PV<br>REAL L      | ,PG<br>IFTÁ , LIFT                          | , PP                     | PR               | . P#             | ,DPDY(3,8)              | GENF         |
| 6                         | * ISP. I           | IFTR , LIFT<br>SPF, MACHY,L<br>3N TPH1(10), | 1570 1002                | in,              | MACH,            | MACHR,                  | GENF<br>FRAT |
| 7.                        | DIMENSI            | N TPHIC101                                  | รัรรับ (โอร์             | LV               |                  |                         | SENF         |
| 8                         | EGDIVAL            | ENLECTEPLITP                                | HĨ),(ŤĽŚL.Y              | IST1)            |                  |                         | GENE         |
| 9                         | CUMMUN/            | REBAI/                                      |                          |                  |                  |                         | ARCD         |
| 0                         | +SREF              | ,EJ                                         | XISP                     | ,TAULT           | DTMC             | ,DTPI                   | . ARCD       |
| 1 2                       | *IATM              | TUBBLE                                      | JAFA                     | JPRO             | _OMAX            | LAAX                    | , ARCD       |
| 2<br>3                    | ≠XLMAX<br>≠MAEB    | LAMMAL                                      | GMODI                    | _ALFMAX          | PHMAX            | AAEA                    | ARCD         |
| 3<br>4                    | *MI<br>*MED        | MAEC                                        | MAED                     | , MAEE<br>, MZCG | , MAEF<br>, MUDA | , MAEG<br>, MWDB        | ARCO         |
| 5                         | *MBB               | ICGR                                        | ZCGR                     | 11-              | , ZE             | ,XT                     | ARCD         |
| 6.                        | *DREF              | . PICND                                     | RHOB                     | ,âĀULT           | , REMAX          | , • 1                   | ARCO         |
| 7.                        | * ,FRATE           | , ARCD(9)                                   |                          | ,                | ,                |                         | RETA         |
| 8.                        | # FRATE<br>DIMENSI | N ARCDA(40                                  | }                        |                  |                  |                         | ARCD         |
| 9.                        | EQUIVAL            | ENCE(SREF, AR                               | CDA)                     |                  |                  |                         | ARCO         |
| D.                        | COMMON/            | DATA/                                       |                          | ••               |                  |                         | DATA         |
| 1<br>2                    | ≠P1<br>≠FTNM       | , RAB                                       | ,ROI                     | ,SE              | , UMF            | ,TAPE                   | , DATA       |
| 3                         | TIMENCI:           | CAR<br>ON ZERO(110)                         | ,JOP1                    | ,J0P2            | , JOP 3          | JOP4                    | DATA         |
| 4                         | EBHILANI           | NCE (ZERO, A                                | ACHB )                   |                  |                  |                         | P014<br>P014 |
| 5                         |                    |                                             |                          |                  |                  |                         |              |

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| 76.<br>77.<br>78.<br>79.<br>80.<br>81.                   | •   |           | GR ,ER ,OMGZ ,XLAMRF ,YMURF ,UM<br>-,JJDP(10) ,IFATAL ,NARC ,NARAM ,NFARC ,ID(4)<br>-,KTAB12C) ,ITAB12D) ,SIE ,MAXTAB<br>-,EM ,PSIR, IPFLG1 , IPFLG2, IPFLG3, IPFLG4, INEQFL(20)<br>-,ITPSO ,KSOL KGLOBL(8)<br>-EQUIVALENCE(INOF, INEQFL(20))<br>EQUIVALENCE(INEDS, ILAB12)) | GLOBAL<br>GLOBAL<br>GLOBAL<br>GLOBAL<br>RETAP<br>NOS<br>APR27      |                                        |
|----------------------------------------------------------|-----|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------|
| 83<br>84<br>85<br>86<br>87<br>88<br>90<br>91<br>92<br>93 |     | 1 2       | ZERD COMPUTATION AREAS IN COMMON  OO 1 I=1,110  ZERO(I)=0.  DD 2 I=1,54  AEZRO(I)=0.  LIFT=0.  BRAG=0.  GAMRD=GMDDT+RDI  I. WAITIALIZ BIVARIATE AERO  IF(JAER.ME.2) GO TO 30  IF(JJJ.NE.999) SO TO 20                                                                        | COMM<br>PO14<br>APR27<br>APR27<br>APR27<br>PROPB<br>PROPB<br>PROPB | 30                                     |
| 96.<br>97.<br>98.                                        |     | 10        | JJ=MAEA CALL INBVAD(JJJ) 60 TO 30                                                                                                                                                                                                                                            | PROPB<br>PROPB<br>PROPB                                            | 30-                                    |
| 99.                                                      |     | 26        | IF(JJJ.NE.MAEA) SO TO 10                                                                                                                                                                                                                                                     | PROPB                                                              | 10-1                                   |
| 100.<br>101.<br>102.<br>103.                             | . C |           | CONTINUE INITIALIZE AIRBREATHER IF(IARC.EQ.NST) KKK =999 IF(IARC.EQ.NST.) KKK =999 IF(IARC.EQ.NST.) KKK =999 IF(IARC.EQ.NST.) KKK =999 IF(IARC.NE.999) GO TO 320                                                                                                             | PROPS<br>FIXED<br>FIXED<br>FIXED<br>FIXED                          | 350                                    |
| 105.<br>106.<br>107.                                     |     | 310       | KKK = MWDB<br>Call Inbyfd(KKK)<br>50 TO 350                                                                                                                                                                                                                                  | FIXED<br>FIXED<br>FIXED                                            | 350                                    |
| 108                                                      |     | 320       | IF (KKK.NE.AWDB) GO TO 310                                                                                                                                                                                                                                                   | FIXED                                                              | 310-1                                  |
| 109.<br>110.<br>111.<br>112.<br>113.                     |     |           | CONTINUE I-A SET UP FLAG FOR INEQUALITY CUTT OFF (ADJOINT DISCONTINUITY) INEDS=0 IF(IARC.LE.1) BO TO 39 IF(INEQFL(IARC-L)) 31,31,39                                                                                                                                          | FIXED<br>NOS<br>APRZ7<br>NOS<br>NOS                                | 39———————————————————————————————————— |
| 114.                                                     |     | 31        | 1F(J5-33) 39,32,33                                                                                                                                                                                                                                                           | NOS                                                                | 32-33-3                                |
| 115<br>116                                               |     | 32        | IF(QMAX_EQ.ORG([ARC-1)) INEDS=1<br>80 TO 39                                                                                                                                                                                                                                  | APR27<br>NOS                                                       | ]3                                     |
| 117.                                                     |     | 33        | IF(JS-35) 34,35,39                                                                                                                                                                                                                                                           | NDS                                                                | 34 35 3                                |
| 118                                                      |     | 34        | 60 TO 39                                                                                                                                                                                                                                                                     | APR27<br>NOS                                                       | , 3                                    |
| 120.                                                     |     |           | IF(REMAX.EQ DAG(IARC-1)) INEDS=1                                                                                                                                                                                                                                             | APR27                                                              | <u></u>                                |
| 121<br>122<br>123<br>124<br>125<br>126                   | . C |           | CONTINUE II 'TEST FOR MOMENT BALANCE AND INITIALIZE ENG. DEFL. JP2 = 1 CDE = 0. JF(JAER.NE.3) 60 TO 40 JP2= 2                                                                                                                                                                | MOS<br>PROPB<br>PROPB<br>PROPB<br>PROPB<br>PROPB                   | 40                                     |
| 127<br>128<br>129<br>130<br>131<br>132                   | . ( | 46<br>: I | CONTINUE<br>J-A TEST FOR AIRBREATHER<br>IF(JPRO.NE.2) 60 TO 45<br>JPRP=1<br>JPRP=1<br>RETURN                                                                                                                                                                                 | PROPB<br>FIXED<br>FIXED<br>FIXED<br>FIXED<br>FIXED                 | 45                                     |
| 133<br>134<br>135<br>136                                 | . ( | ;<br>     | CONTINUE III INITIALIZE PROPULSION BURN TIME AND CURVE NUMBER AE=EJ=TMULT IF(MT) 50,90,50                                                                                                                                                                                    | FIXED<br>PROPB<br>PROPB<br>PROPB                                   | 56-790-7                               |
| 137<br>138<br>139<br>140<br>141                          |     | ;         | TBURN = TBU(IARC) ATT = MPIN(IARC)  III-A TEST FOR ACCEL LIMIT AND SET ROCKET FLAG IF(GMAX)60,60,70                                                                                                                                                                          | PROPB<br>PROPB<br>COAN<br>COAN<br>PROPB                            | 60 70 7                                |
| 142                                                      |     | 60        | JPRP= 2                                                                                                                                                                                                                                                                      | PROPE                                                              | 1 3 1                                  |

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80-
143.
                              60 TO 80
   PROPB
144
145. C
146 C
   PROPB
COAN
COMN
                      70 JPRP =3
                              I I I -B
   THROTTLING AND DUAL ENGINE LOGIC
147
148.
149
                      86 | F(MISP.EQ.O.AND.JPRO.EQ.O) RETURN
| F(JPRO.EQ.1) CALL ISPIN
| IF(FRATE.EQ.O) 60 TO 85
  AAA
  AAA
Frat
  85-
                      82 FRATED = FRATE * TMULT
RETURN
85 CALL SPLYNE(MTT, O., FRATE, BUM)
GD TO 82
150
151
   FRAT
FRAT
152.
153.
   FRAT
APR72
   82-
                      90 JPRP=1
FVAC=0.
T=0.
154.
155.
156.
157
158.
160.
161.
162.
163.
164.
165.
166.
  PROPB
PO19
PO19
COMM
COMM
FRAT
PH15Z
FRAT
FRAT
FRAT
FRAT
FRAT
FRAT
               C
                             III-C USE RATED THRUST IF INPUT
IF(FRATE.LE.O.) RETURN
AE = EJ*THULT
MTT=0
FVAC = FRATE * THULT
IF(JPRO.EQ.1) CALL ISPIN
FRATED = FVAC
IF(GMAX.ST.O.) 60 TO 100
JPRP = 2
RETURN
   100-
                   100 JPRP = 3
T=FVAC
RETURN
END
   FRAT
PHISZ
APR
PROPB
168.
169.
170.
171.
```

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# SUBRØUT INE PRØP IN

#### Subroutine PROPIN

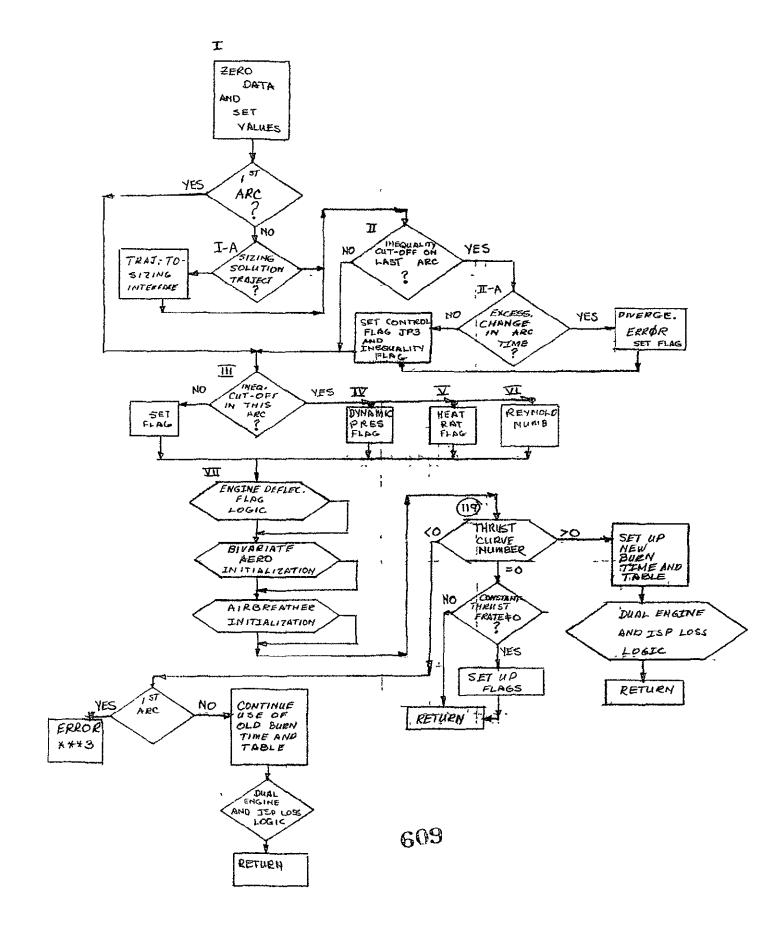
# Purpose

Subroutine PROPIN performs are initialization for the forward trajectory.

# Description

PROPIN is called from FNTG.

# SUBROUTINE PROPIN



| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                  |                    | S TORAL<br>BLOCK | SF<br>LO€ | SUBBOUTINE<br>SUBB CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                     |
|-------------------|----------------|------|----------------------------------------------|--------------------|------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| AĒ                | Auxit          | 0    | Total nozzle exit area                       |                    | /GENF /(         | 520}      | FH2 I A IMPUL I A PROPB O A PROPIN O A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 15<br>15<br>16<br>16<br>16<br>16<br>16                                              |
| AEZRO             | α old          | 0    | Angle of attack from last nominal trajectory | (DEG)              | /AEC03 /(        | 1)        | AST3 M AFNTG I AMTX3A I ACUT I APROPB O A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | APHO<br>APHO<br>APHO<br>APHO<br>AEZRO<br>AEZRO                                      |
| CDE               |                | 0    | Constant value of engine deflection          | (RAD)              | /GENF /(         | 553)      | PROPB 0 C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CDE<br>CDE<br>CDE                                                                   |
| DRAG              | D              | 9    | Aerodynamic drag                             | (LBS)              | /GENF /(         | 497)      | ACCEL I D<br>BL5 I D<br>BL7 I D<br>BL8 I D<br>ENVPRM I D<br>FM3 I D<br>PROPB O D<br>PROPBN O D<br>SDER3 I D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG                        |
| DTNC              | Δτ             | 1    | Integration interval                         | (SEC)              | /ARCDAT/(        | 5)        | FNTG I D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DTNC<br>DTNC<br>DTNC<br>BTNC                                                        |
| DVAR              | ÿ              | 0    | State vector derivatives in steepest descent | anodαle            | /STATE3/(        | 15)       | ADICSA I CADIDSA M CODERSA I VENVPRM I CORNUPRM I CORNUPRM I CORNUPRO I VENUPRO I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CORNUS I CO | DVAR<br>DVAR<br>JVAR<br>JVD<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR |
| EJ                | Aexit          | 1    | Nozzle exit area                             | (FT <sup>2</sup> ) | /ARCDAT/(        | 2)        | PROPIN I E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EJ<br>EJ                                                                            |
| FRATE             |                | I    | Input rated vacuum thrust per engine         | (LBS)              | /ARCDAT/(        | 42)       | FXDAT I F<br>PROPB I F<br>PROPIN I F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | FRATE<br>FRATE<br>FRATE<br>FRATE<br>FRATE                                           |
| FRATEB            |                | 0    | Net rated maximum rocket vacuum thrust       | (LB\$)             | /GENF /(         | 567)      | IMPUL I F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | FRATE<br>FRATE<br>FRATE                                                             |
| FVAC              |                | M    | Total vacuum thrust [rocket]                 | (LBS)              | /GENF /(         | 528)      | ACCEL I FEURAS M FFH2 I FFH2 I FFHPUL M FFHPPB M FFHPPIN M FFHPPIN M FF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC                                        |
| GAMMAD            |                | 0    | Pitch rate                                   | (RAD)              | /GENF /(         | 564)      | BL4 I C<br>PROPB O C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | GAMMA<br>GAMMA<br>GAMMA                                                             |

30 DCT 72 G.01-46

| FORTHAN    | MATH             | CODE | DECEDITION                                                                                                                                                                    | STORA     |      | SUBROUTINE                                                                                                        |                                                                                                                               |
|------------|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL     | SYMBOL           | CODE | DESCRIPTION                                                                                                                                                                   | BLOCK     | LOC  | SUBR CODE                                                                                                         | VAR                                                                                                                           |
| GMAX       | G <sub>max</sub> | 1    | Maximum total acceleration g load                                                                                                                                             | /ARCDAT/( | 12)  | BL5 I<br>FH3 I<br>MOOELA I<br>PROPB I<br>PROPIN I                                                                 | GMAX<br>GMAX<br>GMAX<br>GMAX<br>GMAX                                                                                          |
| GMDOT      | 7±               | I    | Pitch rate (DEG/SEC)                                                                                                                                                          | /ARCDAT/C | 15)  | DER3A I<br>MODELA I<br>MODELB I<br>PROPB I<br>PROPIN I                                                            | GMOOT<br>GMOOT<br>GMOOT<br>GMOOT<br>GMOOT                                                                                     |
| IARC       |                  | 1    | Arc number                                                                                                                                                                    | /XCODES/( | 146) | ADICB3 I ADID3A I ADJUST I BATG M ENVPRM I FATG M ENVPRM I FATG M MODELA I PROPB I REU3 I SDINP M STAU I TRTOSZ I | I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC |
| IND        |                  |      | Flag indicates whether on first nowinal trajectory (IND=1)                                                                                                                    | /XCOBES/( | 141) | AST3 I<br>BGET3 I<br>FNTG M<br>GUI3A I<br>MTX3A I<br>PROPIN I                                                     | IND<br>IND<br>IND<br>IND<br>IND<br>IND                                                                                        |
| INEQFL     |                  |      | A 20 mord array that contains the code number of<br>the state variables inequality constraint that<br>applies on each subarc. A zero entry indicates<br>that no SVIC applies. | /GLOBAL/( | 73)  | PROPB I<br>PROPIN M<br>STP3 M                                                                                     | INEQFL<br>INEQFL<br>INEQFL                                                                                                    |
| IOPEN      |                  | 0    | Closed to open-loop control switch when equal to 2                                                                                                                            | /xcodes/( | 142) | FNTG M<br>Propin o                                                                                                | IOPEN<br>IOPEN                                                                                                                |
| 1 S T AR T |                  | 0    | Initialization and divergance flag                                                                                                                                            | /xcodes/( | 147) | AST3 D BLGCON D BLYNE D FNTG I MODELA D PROPIN D REU3 I TEST M TOPM M                                             | ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART                                                  |
| ITER       |                  | I    | Trajectory pass indicator.  ITER = 1, CONSTRAINTS  = 2, OPTIMIZATION  = 3, SOLUTION                                                                                           | /XCODES/( | 149) | AST3 I<br>FNTG I<br>GETIT I<br>MODELA I<br>OUT I<br>PAYO2 M<br>PROPIN I<br>TEST M<br>TOPM M                       | ITER ITER ITER ITER ITER ITER ITER ITER                                                                                       |
| JAER       |                  | 1    | Aerodynamic model option flag                                                                                                                                                 | /ARCDAT/( | 9)   | BEROCO I<br>EQUAS I<br>GEINP I<br>OUT I<br>PROPB I<br>PROPIN I<br>VT I                                            | JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER                                                                          |
| ORGL       | 3 01-46          | I    | Propulsion model option flag                                                                                                                                                  | /ARCDAT/( | 10)  | EQUAS I<br>GEINP I<br>IMPUL I<br>MODELA I<br>PROPIN I                                                             | JPRO<br>JPRO<br>JPRO<br>JPRO<br>JPRO<br>JPRO                                                                                  |

| FORTRAN | MATH           | CODE       | DESCRIPTION                                    |       | STORAL     |      | SUBROUTINE                                                                            |                                                              |
|---------|----------------|------------|------------------------------------------------|-------|------------|------|---------------------------------------------------------------------------------------|--------------------------------------------------------------|
| SYMBUL  | SYMBOL         |            | DESCUTATION                                    |       | BLOCK      | LOC  | SUBR LOOF                                                                             | VAR                                                          |
| JPRP    |                | 0          | Propulsion flag for different rocket options   |       | /XC00E5/(  | 194) | ACCEL I DERSA I EQUAS I MODELA I POYSA I PROPB D PROPIN O                             | JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP<br>JPRP         |
| JP1     |                | <b>0</b> i | Option flag for first governing equation       |       | /xcodes/(  | 217) | AST3 M<br>MODELA M<br>MODELB I<br>PROPB O                                             | JP1<br>JP1<br>JP1<br>JP1<br>JP1<br>JP1                       |
| JP2     |                | 0          | Option flag for second governing equation      |       | /XCODES/(  | 218) | MODELA I<br>MODELB I<br>PROPB O<br>PROPIN O                                           | JP2<br>JP2<br>JP2<br>JP2                                     |
| 163     |                | 0 1        | Option flag for third governing equation       |       | /XCODE\$/( | 219) | MODELA M<br>MODELB I<br>OUT I                                                         | JP3<br>JP3<br>JP3<br>JP3<br>JP3<br>JP3                       |
| JS      |                | I (        | Absolute value of arc cut-off option code      |       | /XCODES/(  | 153) | ADICB3 M<br>ADIC3A I<br>ADID3A I<br>BNTG M<br>FNTG M<br>PROPB I<br>PROPIN I<br>STP3 I | 12<br>12<br>12<br>13<br>15<br>15<br>15<br>15                 |
| LIFT    | L              | 0          | Aerodynamic lift (                             | (LBS) | /GENF /(   | 496) | BL4 I<br>BL5 I<br>BL6 I<br>ENVPRM I<br>FH3 I<br>OUT I<br>PROPB O<br>PROPIN O          | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT |
| MAEA    |                | I          | Curve number                                   |       | /ARCDAT/(  | 18)  | GEINP I<br>PROPB I                                                                    | MAEA<br>MAEA<br>MAEA<br>MAEA                                 |
| WISP    |                | I (        | Curve number kISP joss table                   |       | /ARCDAT/(  | 26)  | IMPUL I<br>PROPB I                                                                    | MISP<br>MISP<br>MISP                                         |
| MPIN    |                | o :        | Save thrust curve numbers for adjoint solution |       | /XCODES/(  | 197) | PROPB I<br>PROPIN O                                                                   | MPIN<br>MPIN                                                 |
| Tm      |                | 1 (        | Curve number -thrust table                     |       | /ARCDAT/(  | 25)  | FXDAT I<br>PROPB I<br>PROPIN I                                                        |                                                              |
| MTT     |                | M ·        | Thrust curve number                            |       | /XCODES/(  | 196) | PROPB M                                                                               | MTT<br>MTT<br>MTT                                            |
| NARC    | и <sup>3</sup> | 1 4        | Number of subarcs in the problem.              |       | /GLOBAL/(  | 18)  | FNTG I<br>GEINP M<br>PROPIN I<br>SDINP I                                              | NARC<br>NARC<br>NARC<br>NARC<br>NARC                         |

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| FORTRAN<br>Symbol | MATH<br>Symbol    | CODE DESC                                       | RIPTION                        | STOR/<br>BLOCK | LOC    | SURROUTINE<br>SUBR CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | USAGE<br>VAR                                                       |
|-------------------|-------------------|-------------------------------------------------|--------------------------------|----------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| RDI               |                   | I Angle to radian conver                        | sion, .01745329252             | /DATA /6       | 31     | BLICO' I<br>DERSA I<br>FNTG I<br>GUISA I<br>MODELA I<br>MODELA I<br>PADSI D<br>PROPEN I<br>PROPEN I<br>PROPEN I<br>SUINP I<br>SUINP I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI |
| Τ                 |                   | 8 Thrust                                        | (LB\$)                         | /GENF /        | , 411) | ACCEL I<br>BLGCON M<br>BL4 I<br>BL7 I<br>BL7 I<br>BL8 I<br>EQUAS<br>FH1 I<br>FH3 I<br>FH4 I<br>I I<br>PROPBIN O<br>PROPBIN | T                                                                  |
| TBU               |                   | O Saved rocket burn init adjoint integration (s | iation times used during<br>d) | /GENF /        | 500)   | PROPB I<br>Propin O                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | TBU<br>TBU                                                         |
| TBURN             | t <sub>b</sub>    | M Rocket burn instintion<br>trajectory[sd]      | time on forward                | /GENF /        | ( 499) | EQUAS I<br>MODELA I<br>PROPB O<br>PROPIN M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | TBURN<br>TBURN<br>TBURN<br>TBURN                                   |
| TIME              | t                 | I Time (elapsed)                                |                                | /GENF /        | ( 493) | ADICB3 D<br>AST3 I<br>BNTG M<br>CON3 I<br>ENVPRM I<br>EQUAS I<br>FNTG M<br>MODELA I<br>OUT I<br>PROPIN I<br>REU3 M<br>RKTA3A M<br>RKTA3A M<br>RKTA3A M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | TIME TIME TIME TIME TIME TIME TIME TIME                            |
| TMULT             | T <sub>mult</sub> | I Thrust multiplier or n                        | u≡ber of engines               | /ARCDAT/       | ( 4)   | EQUAS I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                    |
| TST1              |                   | I Arc end times for nomi                        | nal trajectory                 | /GENF /        | ( 433) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1       |
| ZERO              |                   | O Partial of mach number                        | prt altitude                   | /GENF /        | ( 524) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | MACHR<br>ZERO<br>ZERO<br>MACHR                                     |

30 OCT 72 G 01-46

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE     | DESCRIPTION                         | STO<br>BLOCK | RAGE    | SUBBOUTIN<br>SUBB COD                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------|----------------|----------|-------------------------------------|--------------|---------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22                |                | I Array  | of variables for adjoint integratio | n /STATE3    | 3/( 29) | ADEO3A I<br>ADICB3 D<br>ADICB3 O<br>PROPIN I<br>RKTB3A M<br>RKTB3A M<br>STRAN3 M          | VARL<br>VARL<br>VARL<br>ZZ<br>F<br>Y<br>VARL<br>VARL                                                                                                                                                                                                                                                                                                                                                                                                              |
| UNO6.             |                | O File o | f all output data                   | / UNG6       | /(\$ )  | BLICTY HOLD OF THE PRINTER PRINTER PRINTER NEED TO DO | UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. UNO6. |

PROPIN

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SUBROUTINE PROPIN THIS ROUTINE FOR FORWARD COMMON/AECO3/
*APHO COSPHI GOPH COSPHI COPH COM CHARLES COSPHI COPH COM CHARLES COSPHI COM CHARLES COSPHI COM CHARLES COSPHI COM CHARLES COSPHI COM CHARLES COSPHI
  PROPIN APPROPIS APPROPIS APECODS APECO
   PERFORMS ARC INITIALIZATION TRAJECTORY
   C
   ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
  PDA
SINPHI
CDG
CLGM
FKM
   NF/

, OMGP(20,2), VARQ(9),

, ACON(9) , BCON(9),

DT , G

, RE , MACH,

, PAR , TIMES,

, TIMEPH , TIMES,

, TPH (20), DIS(20),

, LIFT , CPU, CPU, CPU,

, LIFT , FPOLD,

, DRAG, FYAC

, LIFTA , DBR
   TOL(9) SVAR(10)
COTI(9,9) DCON(9)
DPA RO
CSR VNR
TOP TOS
DIP(20) T
DIS1(20) TIME
TAX TBURN
FPD MACHR
LIFTY DRAGR
DB ISP
   GENF
GENF
GENF
GENF
GENF
GENF
  *OMG(20)
*A(9,9)
*BTS
  , BL
, G
, MACH
, ROR
, TIMES
(20), DIS(20)
(20), DRAG
, FPOLD
, FVAL
   ≠A
≠VNU
   *VNU
*SYSQ
*TST(20)
*TLP1(20)
*TIMPR
*AE
*OR
*LIFTR
   PARTE SEED OF 
   DRAGA
ISPF
ULFTA
CODAE
SID
  ORAGR
ISP
ULFTR
XMCGM
  DBR
ULFT
XMCGR
CALPHA
XCS
   DHAGV
DLFTV
XMCGA
CDE
ZCG
   *XMCG
*CULFT
*COD
COMMON
*XJV
*FRATED
*P1
  XMCGV
CT
SIDAE
GENF /
XJR
IRATED
  , DELTAE
   , GAMMAD
   , GH
  , XKG
   , XKP
   #FRATED | IRATED | GH | G | FP1 | P2 | P3 | XK | XK1T | XK2T | XK3T | X | XK1H | XK2A | XK3A | XK1G | XK2A | XK3G | XK1G | XK2B | XK3G | XK3G | XK3H | XK2B | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H | XK3H 
   , xk3
, xk3p
, xk3v
, xk3v
, xk3p
, xk3m
, DPDY(3,8)
MACHR,
   , XK1
, XK1D
, XK1V
, XK1P
, XX10
, XK1M
, PR
  , XK2
, XK20
, XK2Y
, XK2P
, XK20
, XK2M
   , P0
  MACH,
  JGIO(20,2),JPH (20,2),
NSAB ,NICNB ,
IFB ,ND ,
IARC ,ISTART ,
JPS ,JS ,NAD ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NPH ,NCASE ,NCASE ,NCASE ,NPH ,NCASE
   INTB
INSB
IFAR
ISST
JK
KST
NOP
ISTOP
ISTOP
   CDMMO!
*ITQ
*JST
*I2OP
*IOPEN
*ITCT
*KOP
*NCN
*NST
   (20),ITI
,NCNST
,IFAH
,ISPH
   ICOP
IPH
ITER
KPST
NEOB
IPST
IBLKI
   IVAR
,K
,NEQ
,1PRINT
,IBLK2
  XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XTATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
  , ISTNB
  ,L
,NPHB
   JPŽ,JPŠ
  , SVY(10)
  SAVBP(15)
   ,00V
,006
,00R
,00P
   STATE30
STATE30
  *POU , DDU , EDU , EL REAL MON , MI COMMON/STATE3/ *SIN2RO , COS2RO COMMON/GLOBAL/
   STATE30
   STATE3D
STATE3D
GLQBAL
   , COSZG#
   , DMGZ
NARC
   ,XLAMRF
,WBRAN
,MAXTAB
  , YMURF
   *GR ,ER
*,JJBP(10),IFATAL
   ,LUA
,ID(4)
   GLOBAL
   *, JJBP(10), 17AB(20)
  ,516
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```
*,6M PSIRF, IPFL61, IPFL62, IPFL
*,1TPS0 ,KSÚL ,KGLOBL(8)
EAAL MUB, MUD, ISPB, ISPD, IDVEL, NNB, ND
COMMON /5IZINÉ/
PHASE II SIZING PARAMEHERS
*IZ, VV(3), QP(14), EROR, PZ
*SV(28), SG(37,5), SE(11), TLAT, I
PHASE I SIZING PARAMEHERS
*WB0, MLOO, DWEB, OMEO, T
*BK1, BK2, BK3, BK4, I
*OK1, GK2, GK3, GK4, P
*AEXIT, TVACO, NO, MFO, I
*IPL, TVACO, NO, MFO, I
*IPL, TVACO, NO, MEO, MEO, M
*DV0, DVB, MUB, MUO,
*JTPL, TVACO, NO, MB, MEO, M
*JTPL, TVACO, NO, MB, MEO, M
*JTPL, BECO, BSTG, ORBI, IT
*SVDP$0, SVDCON, IHUNI, JOPSTG, IS
  76.
11.
78.
79.
  GLOBAL
RETAP
SIZINS
  IPFLG2, IPFLG3, IPFLG4, INEQFL(20)
   SIZINS
SIZINS
SIZINS
SIZINS
SIZINS
SIZINS
SIZINS
SIZINS
SIZINS
SIZINS
SIZINS
   С
  PZ(5),
TLNG,
   81.
82.
  SW( 26 ),
   ۷Q,
   83.
  TOLUT,
ISIZE,
PAFLS,
IDVEL,
WES,
VSTS,
ITNBU
  TWRAT2,
TWRATO,
IPSMAX,
ISPB,
WLO,
   WPB,
TRAFLG,
1PASS,
1SPO,
WO,
  84.
85.
   86.
87.
   *OK1 OK2

*AEXIT, TYACO,

*XPL, TYACB,

*DV0, BVB,

*JTYP, BECO

*SVBPSQ SVDCON

COMMON/ARCDAT/

*SREF EJ

*IATM IMDDE
  88.
89.
90.
  ITNOW
   SIZING
  ,IHUNT
   JIZING
UH
ARCDAT
ARCDAT
ARCDAT
ARCDAT
ARCDAT
  ,107516
                                       91.
92.
93.
94.
95.
97.
98.
101
102.
103.
104.
105.
106.
  XISP
JAER
SMDOT
MAED
MXCS
ZCGR
RHOB
   TAULT
JPRO
ALFMAX
MAEE
MZCS
XE
QMULT
   DTNC
OMAX
PHMAX
MAEF
MUDA
ZE
REMAX
  DTPI
, GMAX
, MAEA
, MAEG
, MWDB
   , HOMAX
, MAEC
, MISP
, XCGR
  * XI MAX
   +MAEB
+MI
+MDB
  ARCDAT
                                  108
109
1110.
                                  di 12:
                                      1113.
1114.
1115.
1116
1117.
1118.
1119.
   LIFT=0.
LIFT=0.
DRAG=0.
GAMMAD=GMDOT*ROI
ILAB(1)=0
JP3 = 2
  APR27
APR27
PO14
PO14
PROPIN
APR27
   BVAR(8)=0.
  INGF =0
IF(IARC.LE.1) SD TO 4
I-A TEST FOR SIZING
IF(ITER EQ.3.AND.JTYP.GT.0) CALL ARCEND
   PROPIN
   PHISZ
PHISZ
PHISZ
                                       121.
   C
                                       123
  F(ITER EG.3.AND.JTYP.GT.O) CALL ARCEND

4 CONTINUE

II TEST AND SET INEQUALITY FLAG INGF

IFFIARC.EQ.1) GO TO 20

IFFIREQFL(IARC-1).EQ.O) GO TO 20

II-A TEST FOR EXCESSIVE CHANGE OF CUT-DFF TIME

IFFIND.EQ.1) GO TO 16

TAT=ABS(TSTI(IARC)-TIME)

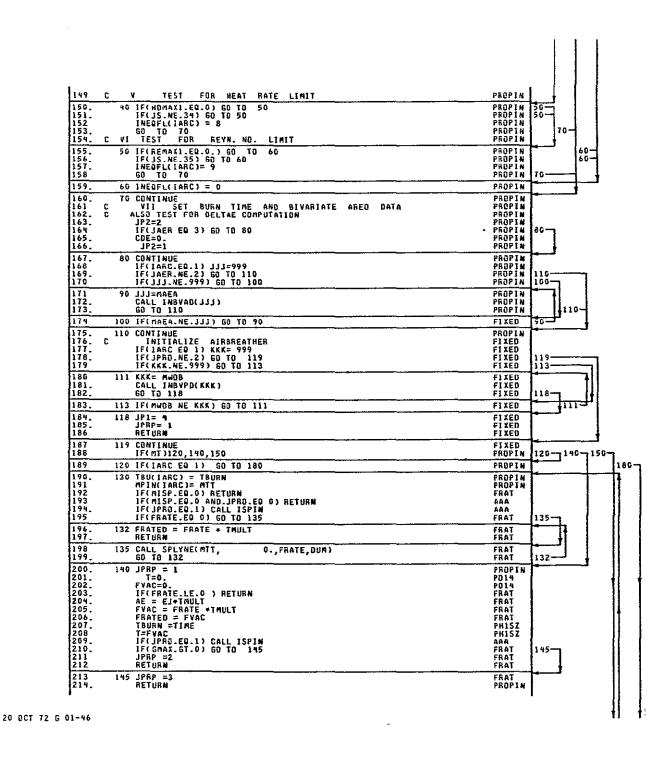
IFFITAT.LE.10.) GO TO 15

WRITE(6,12)

12 FORMAT (53H *****ERROR*** EXCESSIVE CHANGE IN ARC CUT-DFF TIME

ISTART-6
                                       124
125.
126.
127.
128.
129.
130
131.
132
  PHISZ
PROPIN
PROPIN
PROPIN
  C
   20~
20~
  C
   PHISZ
APR27
   16-
   15~
  APR27
  APR27
APR27
APR27
  135
   15 IF(TAT.ST 4.+DTNC) 10PEN=2
   APRZI
  16 CONTINUE
INDF = INEQFL(IARC-1)
JP3 = INDF
                                       136
137
138
   PH15Z
PROPIN
   PROPIN
  20 IF(IARC.EQ.NARC) GO TO 60
III TEST FOR WHETHER AN INEQUALITY CUTOFF EXISTS IN CURRENT ARC
                                       139.
   PROPIN
PROPIN
                                       140.
141.
142
   PROPIN
PROPIN
  IF((JS-33)*(JS-34)*(JS-35)) 60,30,60
  30 - 60
  30 CALL READMS(9, ZZ, 41, IARC+1)
1V TEST FOR DYN. PRES. LIMIT '
1F(UMAX) EQ.O.) GO TO 40
1F(JS NE.33) SO TO 40
1NEOFL(IARC) = 7
GO TO 70
                                       143
144.
145.
146.
147
148.
  PROPIN
PROPIN
PROPIN
PROPIN
PROPIN
PROPIN
  #0
#0
   70.
25 DCT 72 6.01-46
```

646



```
FROPIN
FROPIN
PROPIN
PROPIN
PROPIN
FROPIN
FROPIN
PROPIN
PROPIN
PROPIN
PROPIN
PROPIN
PROPIN
                                 150 TBURN = TIME

ATT = ATT

AE = EJ* TMULT

IF(GMAX) 160,160,170

160 JPRP = 2

60 T0 130

170 JPRP = 2
215
216
217
218.
219.
220
221.
222
223
224.
                                170 JPRP = 3

60 TO 130

180 CALL STPIT (3)

END
   PROPIN PROPIN
```

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# SUBRØUT I NE REU3

#### Subroutine REU3

Entry Points EQIN, SVADYS, SAVVR, SAVDYP, INTBC, BRST, BRIN, MSDISC, CORVAR.

### Purpose

EQIN. Initialize state and control vectors and calculate reference point trigonometric functions.

SVADYS: Save derivatives, y, at arc end points.

SAVVR: Save current state for use in cut-off refinement.

SAVDYP: Save derivatives, y, at phase end point.

INTBC: Evaluate intermediate arc end constraint misses.

BRST: Save state at end of trunk to reinitialize integration for second branch.

BRIN: Evaluate first branch constraint misses and initialize state for beginning of second branch.

MSDISC: Compute mass at beginning of next arc.

CORVAR: Refine mid-integration point state estimate and store.

| FORTRAN | MATH                   | COD | E DESCRIPTION                                     |                              | STORAC    |      | SUBROUTIN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | E USAGE                                                                                  |
|---------|------------------------|-----|---------------------------------------------------|------------------------------|-----------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL                 |     | DESCRIPTION                                       |                              | BLOCK     | TOT  | SUBR COO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | E VAR                                                                                    |
| ALPHA   | α                      | 0   | Angle of attack                                   | (RAD)                        | /AECO3 /( | 3)   | BEROCO I<br>BLGCON M<br>BLZ I<br>FNTS O<br>MAMECO I<br>MODELA M<br>MODELA M<br>REU3 O<br>VT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA   |
| CSPSR   | cos(√ <sub>r</sub> )   | C   | Cosine of reference azimuth                       |                              | /088IT /( | 153) | POBC I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CSPSR<br>CSPSR                                                                           |
| CSXLMR  | cos(ρ-ρ <sub>r</sub> ) | 0   | Cosine of reference latitude                      |                              | /ORBIT /( | 147) | PDBC I<br>REU3 B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CSXLAR<br>CSXLAR                                                                         |
| DELTAE  | <sup>&amp;</sup> E     | 0   | Engine gimbal deflection angle                    | (RAD)                        | /GENF /(  | 554) | BLGCON M<br>EL1 I<br>OUT I<br>REU3 O<br>VT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | DELTAE<br>DELTAE<br>DELTAE<br>DELTAE<br>DELTAE                                           |
| DT      |                        | Ī   | Integration interval .                            | (SEC)                        | /GEMF /(  | 300) | BMTG M<br>FMTG M<br>REU3 I<br>RKTA3A I<br>RKTB3A I<br>STP3 I<br>YREF3 O                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | DT<br>DT<br>DT<br>P<br>P<br>DT<br>DT                                                     |
| DVAR    | ÿ                      | I   | State vector derivatives in steepest descent      | module                       | /STATE3/( | 15)  | ADICB3 M<br>ADIC3A I<br>ADID3A M<br>OER3A O<br>DTF3 I<br>ENVPRM I<br>PROPIN O<br>REU3 I<br>RXTA3A I<br>SDER3 D<br>STP3 I<br>VREF3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | DVAR<br>DVAR<br>DVAR<br>VT<br>OVAR<br>VD<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR |
| GR      | 9 <sub>t</sub>         | I   | Gravitational acceleration at surface of the (FT) | earth<br>/SEC <sup>2</sup> ) | /GLOBAL/( | 1)   | ACCEL I<br>BL5 I<br>E0943 I<br>FH3 I<br>GEINP I<br>GEINP I<br>GEINP DUT I<br>PAOS1 I<br>PAOS1 I<br>PAOS1 I<br>PAOS1 I<br>SDINP I<br>SDINP I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE I<br>STIZE | 88888888888888888888888888888888888888                                                   |

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| FORTRAN<br>SYMBOL | MATH<br>SYMBOL | CODE | DESCRIPTION                                                                       | STORAG    | LOC  | SUBROUTINE<br>SUBR CODE                                                                                                           | USAGE<br>VAR                                                                                                   |
|-------------------|----------------|------|-----------------------------------------------------------------------------------|-----------|------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
|                   | 011,000        | ···· |                                                                                   |           |      |                                                                                                                                   |                                                                                                                |
| IARC              |                | I A  | rc number                                                                         | /XCODES/( | 146) | ADIOSA I ADJUST I ADSTS I BNTG M ENVPRM I FNTG M SETIT I PROPB I PROPB I PROPB I PROPIN I SDINP M STAU I STP3 I                   | IARC<br>IARC<br>IARC<br>IIARC<br>IIARC<br>IIARC<br>IIARC<br>IIARC<br>IIARC<br>IIARC<br>IIARC<br>IIARC<br>IIARC |
| IPST              |                | I PI | hase counter for first nominal trajectory                                         | /XCODES/( | 167) | FNTG M<br>GUI3A I                                                                                                                 | IPST<br>IPST<br>IPST<br>IPST                                                                                   |
| ISTART            |                | I 1: | nitialization and divergance flag                                                 | /XCODES/( | 147) | BLGCON O<br>BLYNE O<br>FNTG I<br>MODELA O<br>PROPIN O<br>REU3 I<br>TEST M                                                         | ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART                         |
| NEQ               |                | 1 Nu | :mber of integrated states                                                        | /XCODES/( | 162) | ADIC3A I<br>ADIC3A I<br>ADIC3A I<br>ASETB3 I<br>ASET3 I<br>BGET3 I<br>BTX3A I<br>OUT I<br>BEU3 I<br>SDER3 I<br>SDER3 I<br>TRAN3 I |                                                                                                                |
| NEQF              |                |      | unber of equations to be integrated on forward<br>eajectory                       | /xcodes/( | 185) | RKTA3A I  <br>SDINP 0  <br>STAU I  <br>TOPM 0                                                                                     | NEOF<br>HN<br>NEOF<br>NEOF<br>NEOF                                                                             |
| NI CNB            |                |      | imber of constraints at intermediate constraint<br>oint or at end of first branch | /xcodes/( | 135) | ADICSA I BNTG I REUS I SDINP M TEST I                                                                                             | NICNB<br>NICNB<br>NICNB<br>NICNB<br>NICNB<br>NICNB<br>NICNB                                                    |
| N\$B              |                |      | ımber of arcs prior to branch point or<br>oterwediate constra∶nt                  | /xcodes/( |      | BNTG I I<br>ENVPRM I I<br>FNTG I I<br>REU3 I I<br>SOINP M I<br>TEST I I<br>TRANS I I                                              | 45 B<br>45 B<br>45 B<br>45 B<br>45 B<br>45 B<br>45 B                                                           |
| 0881              |                | 1 Or | biter ignition arc                                                                | /SIZING/( | 316) | REUS I (                                                                                                                          | ORBI<br>ORBI<br>ORBI                                                                                           |

8 NOV 72 G 01-46

| FORTRAN<br>SYMBOL | MATH<br>Symbol               | CODE | DESCRIPTION                                                                                | STORA<br>Blück | GE<br>LOC | SUBROI<br>SUBR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                            | USAGE<br>VAR                                                       |
|-------------------|------------------------------|------|--------------------------------------------------------------------------------------------|----------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------------------------------------------------------------------|
| PSIRF             | ٧ <sub>٢</sub>               | I    | Reference azimuth (OEG)                                                                    | /GLOBAL/(      | 68)       | GEINP<br>REU3<br>SDINP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | I<br>I                     | PSIRF<br>PSIRF<br>PSIRF                                            |
| ROI               |                              | 1    | Angle to radian conversion, 01745329252                                                    | /DATA /(       | 3)        | BLICO<br>DERSA<br>FNTG<br>GUISA<br>MODELE<br>MODELE<br>PADSI<br>PROPE<br>REUS<br>SDIMP<br>SOME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | I<br>I                     | ROI<br>ROI<br>ROI<br>ROI<br>ROI<br>ROI<br>ROI<br>ROI<br>ROI<br>ROI |
| SAVBP             |                              | M    | Saved state vector at branching point for initializing second brock                        | /STATE3/(      | 689)      | REU3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Ħ                          | SAVBP                                                              |
| SNPSR             | sin( $\psi_{_{_{\Gamma}}}$ ) | 0    | Sine of reference azimuth                                                                  | /ORBIT /(      | 152)      | PDBC<br>REU3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | I<br>0                     | SMPSR<br>SMPSR                                                     |
| SNXLMR            | $sin(\rho - \rho_r)$         | 0    | Sine of reference latitude                                                                 | /ORBIT /(      | 146)      | PDBC<br>Reu3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ī                          | SAXLAR<br>SAXLAR                                                   |
| SQ                |                              | 0    | A synthesis data array (37,5) that contains the flyback data and some injection quantities | /SIZ1NG/(      | 74)       | ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE ENTRE |                            | 33555555555555555555555555555555555555                             |
| SVAR              | У 1 <sub>1=0</sub>           | 1    | Array of state values at initial problem time [sd]                                         | /GENF /(       | 793       | ADJUST<br>BNTG<br>FNTG<br>PRMSET<br>REU3<br>SDINP<br>TEST<br>TOPM<br>TRTOSZ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | I<br>I<br>H<br>I<br>H<br>I | SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR       |
| SVBV              |                              | 0    | Saved state vector on trial trajectory                                                     | /STATE3/(      | 710)      | ADI CB3<br>REU3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                            | SVBV<br>Svbv                                                       |
| S ¥Y              | y-1                          | M    | State and time array at previous compute interval                                          | /STATE3/(      | 236)      | OTF3<br>REU3<br>YREF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A                          | 5 4 4<br>5 4 4<br>5 4 4                                            |

8 NOV 72 G.01-46

| FORTRAN<br>Symbol | MATH<br>Symbol | coo | E DESCRIPTION                    |          | STORA<br>BLOCK | LOC<br>LOC | SUBROUTING<br>SUBR CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | E USAGE<br>E VAR                                                                     |
|-------------------|----------------|-----|----------------------------------|----------|----------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| τ                 | т              | 0   | Thrust                           | (LBS)    | /GENF /(       | 411)       | ACCEL I<br>81.6CON M<br>81.4 I<br>81.4 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 I<br>81.7 | T T T T T T T T T T T T T T T T T T T                                                |
| TIME              | ŧ              | A   | Time (elapsed)                   |          | /GENF /(       | 493)       | AST3 I<br>BNTS M<br>CON3 I<br>ENYPRM I<br>EQUA3 I<br>FNTG M<br>MODELA I<br>OUT I<br>PROPIN I<br>REU3 M<br>RKTA3A M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | TIMEE<br>TTIMEE<br>TTIMEE<br>TTIMEE<br>TTIMEE<br>TTIMEE<br>TTIMEE<br>TTIMEE<br>TTIME |
| VAR               | •              | Я   | Relative velocity                | (FT/SEC) | /STATE3/(      | 11         | ACCEL 1 ADICES 0 ADJUST M AGETBS 0 ASTS I BL4 I BL7 I BL8 I BL8 I DERSA I DERSA I DERVPRM I EQUAS I MODELA I MODELA I MODELA I MODELA I I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I FOR I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | V VARRARRARRARRARRARRARRARRARRARRARRARRARR                                           |
| <b>u</b>          | Ы              | I   | Weight                           | (LBS)    | /GENF /(       | 412)       | ENVPRM 1<br>EQUAS M<br>FH3 I<br>OUT I<br>PDBC I<br>REUS I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | #<br>#<br>#<br>#                                                                     |
| WDC<br>8 NOV 72 6 | 6 01-46        | I   | Array of drop weight per arcisdl | (LBS)    | /GENF /(       | 89)        | BNTG I<br>REU3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | MDC<br>MDC<br>MDC                                                                    |

| FORTRAN<br>SYMBOL | MATH<br>Symbol    | CODE DESCRIPTION                             |       | STORAL<br>BLOCK | E<br>LOC | SUBROU<br>SUBR                     | TINE USAG<br>CODE VAR                      |
|-------------------|-------------------|----------------------------------------------|-------|-----------------|----------|------------------------------------|--------------------------------------------|
| XLAMRF            | ρ <sub>r</sub>    | I Reference latitude.                        | (DEG) | /GLOBAL/(       | 43       | CRASH<br>GEINP<br>REU3<br>S D I NP | M RHOO<br>I XLAMRI<br>I XLAMRI<br>M XLAMRI |
| YDP               |                   | O Array of state derivatives at phase end po | ınts  | /STATE3/¢       | 327)     | ADID3A<br>REU3                     | I YDP<br>D YDP                             |
| YDS               | ÿ1,_              | O Array of state derivatives at arc end poin | ts    | /STATE3/(       | 507)     | ADICB3<br>ADID3A<br>REU3<br>STAU   |                                            |
| YMURF             | · μ <sub>e</sub>  | I Reference longitude.                       | (DEG) | /GLOBAL/(       | 5)       | CRASH<br>GEINP<br>REU3<br>SDINP    | M UMUO<br>I YMURF<br>I YMURF<br>M YMURF    |
| YMXRF             | $ ho_{_{\Gamma}}$ | O Reference longitude                        | (GAR) | /OABIT /(       | 145)     | PDBC<br>REU3                       | I YMXRF<br>O YMXRF                         |

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REU3
REU3
REU3
COMN
ORBIT
  SUBROUTINE REUS
THIS SUBROUTINE PERFORMS VARIOUS STATE DEPENDANT FUNCTIONS FOR ENTG
   000
  EACH FUNCTION IS CONTAINED IN SEPARATE ENTRY
COMMON/ORBIT/ VI, SAMI, PSII, XMUI,
ECC, AINCL, ARGP, ASCNOO, SMIMAJ,
PERGEE, ANOMLY, CAPX, CAPY, ASYMP,
UNIOH, DVIDM, DVIDES, DVIDRO, DVIDRO,
DVIDH DYIDM, DVIDES, DVIDRO, DVIDRO,
DFIOW, DFIDG, DFIDH, OGIDPS, OGIDBO,
DPIOW, DFIDG, DFIDH, DPIDM, DPIDM,
DMIDM, DMIDW, DMIDG, DMIDM, DMIDM,
DMIDM, DMIDM, DFOW, DPDG, DPDM,
DPDPS, DFORO, DPDMU, DECDW, DECDG,
DECDM, DECDPS, DECDRO, DIDRO, DIDMU,
POINTS
  APOGEE,
ENERGY,
   OABIT
ORBIT
ORBIT
  DGIDV,
DGIDAU,
DPIDAO,
DAIOPS,
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DGIDRO,
DPIDPS,
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   DIOM ,
DBEDH ,
DNODG ,
DSMDV,
   DAGDA ,
   BIGH
  DIOPS
  DIGRO
  DBEDPS,
DNCOM
   DBEDRÓ,
DNOOPS,
   DBEDM,
   DBEOMU.
  DNEOH,
DSADG,
  DNODRO,
DSMOPS
   DNODMU,
   COMMON/GRBIT/

* DSMORO, DSMOWU, DAFDV, DAPDG, DAPDH, (
* DSMORO, DSMOMU, DAFDV, DAPDG, DAPDH, (
* DAPDPS, OAFORO, OAFORU, DPEDV, OPEOG, (
* * DPEDM , DFEDPS , OPEDRO , DPEDMU , DANDV
* DANDH , DANDH , DANDPS , DANORO, DANDMU, (
* BCYDG , DCXDH , BCXDA , CXOPS , DCXDRO, (
* DCYDWU , CAYDG , DCYDH , DCYDH , DCYDPS , CC , DCYDH , DCYDH , DCYDPS , C , DCYDHU, DASDW , DASDG , DASDH , DASDH , DASDH , DASDH , DASDH , DENDH , DADDH , DMDDF , DMDDR , DMDDF , DMDDR ,
   OSHDM.
   DSMOH.
  DAPOM
DPEDH
DANÓG
DCXDV
DCXDMU,
   DRBIT
  DCYDRO,
DASDPS,
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PAR , ROR
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*TIMPR
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, FPD
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ULFTR
XMCGM
DELTAE
  DRAGA
ISPF
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,CDE
,ZCG
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                             ULFT
XMCGR
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XCG
                            *XMCG
*CULFT
*COB
COMMON
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  , XKP
   , XKG
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   GLOBAP
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SECCO33
AECCO33
AECCO31
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REUZING
   PDA
SINPHI
CDO
CLOM
FKM
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  SW( 20 ),
   SIZING
   TURATE, SIZING THRATE, SIZING THRATO, SIZING IPSMAX, SIZING ISPB, SIZING INC., SIZING
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CSXL#R= COS(XLAXRF)
SMPSR=SIN(PSIRF+RDI)
CSPSR=CDS(PSIRF+RDI)
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  REU3
REU3
PO14
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PO14
                                       ALPHA=0
                                      DELTAE=0.
T=1.E6
RETURN
  REU3
COMN
COMN
REU3
                             II SAVE DERIVATIVES AT ARC END
ENTRY SVADYS
00 30 1=1,NEQ
30 YDS(1ARC,1) = DVAR(1)
RETURN
  POINT
  REU3
REU3
REU3
COMN
Q161
     163
164.
165.
166
                  £
                              III SAVE STATE FOR CUT-OFF REFINEMENT (SEE YREF)
ENTRY SAVVR
OD 40 I=1, NEQ
40 SYV(1+1)=VAR(I)
SVV(1)=TIME
  COMN
REU3
REU3
REU3
1667.

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  REU3
REU3
COMN
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REU3
                                       RETURN
                     C
                             IV SAVE DERIVATIVES AT PHASE END POINT ENTRY SAVDYP 00 50 1=1 NED 50 YDP(1PST, I) = DVAR(I) RETURN
   REU3
                                      V EVALUATE INTERMEDIATE CONSTRAINT MISS ACCOUNTING FOR WHETHER ON TRIAL OR STARTING TRAJENTRY INTEC 1F(ISTART GT.1) GO TO 60 CALL CONIN(1,NICNB) RETURN
                     CCC
  COMN
  REU3
   60-
  REUS
  REU3
REU3
COMM
COMM
    184
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2001
202
                              60 CALL CON(1, NICHB)
                      CCC
                             VI SAVE STATE AT END OF TRUNK TO REINITIALIZE
INTEGRATION FOR SECOND BRANCH
ENTRY BRST
NPHB=1PST
DD 70 I=1, NEQF
70 SAVBP(I+)= VAR(I)
SAVBP(I) = TIME
BETION
  COMN
REU3
REU3
REU3
  REU3
REU3
                                     VI-B EVALUATE BRANCH 1 CONSTRAINT MISSES AND INITIALIZE STATE TO START BRANCH 2 INTEGRATION ENTRY BRIN NPHP=1PST+1 IF( 1START GT.1) GD TD 80 CALL CONIN(1, NICNB) GD TD 90
  COMN
COMN
                     000
  REU3
REU3
REU3
REU3'
   80-
   90-
  REU3
    203
                             80 COMTINUE
CALL CON(1,NICNB)
  REU3
REU3
                          90 D0 110 I=1, NEOF
100 SVBV(1)= VAR(1)
110 VAR(1)= SAVBP(1+1)
TIME= SAVBP(1)
IF(WDC(IARC-1).NE.O.) RETURN
VAR(4) = WDC(NSB)/GR
RETURN
     205
  REU3
REU3
REU3
REU3
OS
REU3
COMN
COMN
REU3
    206.
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                                     VII COMPUTE MASS AT START OF NEXT ARC
ENTRY MSDISC

WEIGHT DROP LOGIC

VII-A IS WI DROP COMPUTATION FLAGGED (PHASE II SIZING)
GO TO VII-E ELSE VII-B
IF(WDCCIARC-1).ED.-99999999) GO TO 135

VII-B IS NEXT ARC WI. JUST INITIALIZED, GO TO VII-C
ELSE VII-D
IF(WDCCIARC-1))120,130,130
VII-C INITIALIZE MASS FOR NEXT ARC
                     CCC
  PH15Z
   COMN
COMN
PHISZ
COMN
COMN
REU3
COMN
  135
                     C
  126-136-
    221
222
    223.
                        120 VAR(4) =~WDC(IARC-1)/GR
  REU3
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ÓS
OS
REU3
      225
225
226
   REU3
COMN
REU3
OS
DS
REU3
COMN
COMN
      221
228
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230.
231.
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233.
234. L
235 1
236. 237.
238.
239. C
241 C
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   VIII REFINE MID-INTEGRATION STATE ESTIMATE AND STORE ENTRY CORVAR DO 140 I=1, NEQ 140 SYOUGI)=DVAR(I) CALL DER DO 150 I=1, NEQ 150 VAR(I)=SYV(1+1)+(SVOQ(I)+OVAR(I))*QT*.25 CALL ASTO RETURM END
```

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# SUBRØUT I NE RKTA3A

#### Subroutine RKTA3A

### Entry Point RKUTTA

### Purpose

Subroutine RKTA3A is the utility RUNGE-KUTTA integration routine used for integrating the foward trajectory.

### Description

This Runge-kutta package employs a four-cycle method with two derivatives at the mid-integral and two at the end interval. This routine is called from FNTG.

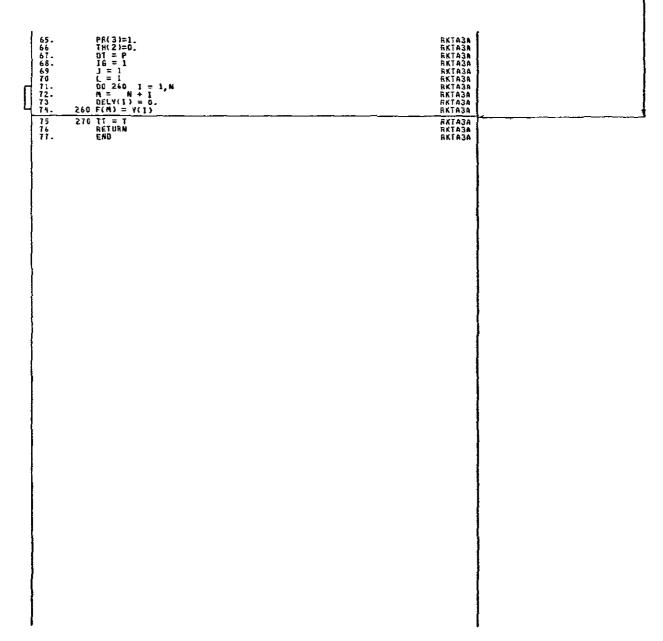
| FORTRAN | MATH   | CODE | DESCRIPTION                                                                                                         |              | <u> 5108</u> |        | SUBROUT1                                                                                                                          |                                                                            |
|---------|--------|------|---------------------------------------------------------------------------------------------------------------------|--------------|--------------|--------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| SYMBOL  | SYMBOL |      | DESCRIPTION                                                                                                         |              | BLOCK        | LOC    | SUBA CO                                                                                                                           | DE VAR                                                                     |
| DY      | ÿ      | 1 5  | tate vector derivatives in steepest de                                                                              | scent module | /STATE3/     | ( 15)  | ADJCB3 M<br>ADJCBA M<br>ADJCBA M<br>DER3A D<br>GTF3 I<br>ENVPRM I<br>POBC I<br>PROPIN O<br>REU3 I<br>SDER3 O<br>STP3 I<br>YREF3 I | DVAR<br>DVAR<br>DVAR<br>VI<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR |
| F       |        | M Ai | ray of variables for adjoint integrat                                                                               | 1 o n        | /5TATE3/     | ( 29)  | ADEQ3A I<br>ADICB3 D<br>ADIC3A D<br>PROPIN I<br>RKTA3A M<br>RKTB3A M<br>STVRL3 D<br>TRAN3 M                                       | VARL<br>VARL<br>VARL<br>ZZ<br>F<br>Y<br>VARL<br>VARL                       |
| J       |        |      | ntegration routine flag tells which de<br>valuation in Runge-Kutta cycle                                            | rıvətive     | /XCODES/     | ( 151) | ADIC3A M<br>BNTG I<br>MODELA I<br>PAYO2 M<br>RKTA3A M<br>RKTB3A M                                                                 | ]<br>  J<br>  K<br>  J<br>  K<br>  J<br>  K                                |
| L       |        | M I  | ntegration traffic control flag  L = 1 means evaluate derivatives  = 2 check cut-off  = 3 print or cut-off detected |              | /xcodes/     | ( 177) | BNTG M<br>FNTG M<br>OUT I<br>RKTA3A M<br>RKT83A M<br>SDINP M                                                                      | L<br>L<br>L<br>L                                                           |
| NN      |        | I No | imber of equations to be integrated on<br>ajectory                                                                  | for≡ard      | /XCODES/     | ( 185) | REU3 I<br>RKTA3A I<br>SDINP O<br>STAU I<br>TOPM O<br>TRAN3 O                                                                      | NEQF<br>NN<br>NEQF<br>NEQF<br>NEQF<br>NEQF                                 |
| P       |        | I In | tegration interval                                                                                                  | (SEC)        | /GENF /      | ( 300) | BNTG M<br>FNTG M<br>REU3 I<br>RKTA3A I<br>RKTB3A I<br>STP3 I<br>YREF3 0                                                           | DT<br>DT<br>DT<br>P<br>P<br>DT<br>DT                                       |
| TP      |        | I Tr | ajectory print time                                                                                                 |              | /GENF /      | ( 495) | BNTG OFNTG MRKTA3A IRKT83A I                                                                                                      | TIMPR<br>TIMPR<br>TP<br>TP                                                 |
| τΥ      | t      | m T: | me (elapsed)                                                                                                        |              | /GENF /      | ( 493) | CON3 I DTF3 I ENVPRM I EQUAS I FNTG M MODELA I OUT I POBC I PROPIN I                                                              | TIME TIME TIME TIME TIME TIME TIME TIME                                    |

| FOHTRAN<br>SYMBOL | MATH<br>Symbol | CODE       | DESCRIPTIO | N        | STORAC<br>BLOCK | LOC | <u>\$ UBRQU</u><br>\$UBR                                                                                                           | TINE USE<br>CODE VE                                                             |
|-------------------|----------------|------------|------------|----------|-----------------|-----|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| •                 | V              | m Relative | velocity   | (FT/SEC) | /STATE3/(       | 1)  | ACCEL ADICB3 ADJUST AST3 BLY BLB CON3A DOTF3 MODDELA MODDELA MODDELA MODDELA MODDELA MODDELA TOPT PDBC RKTA3A RKTA3A RKTA3A TYREF3 | M VAR O VAR I VAR I V VAR I VAR I VAR I VAR I VAR I VAR I VAR I VAR I VAR I VAR |

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| 5 EBUIYALERCE (600(360),P),(600(493),TT),(600(495),TP) 10<br>6 CDMON/XCODES/ 11143) RKTASA<br>7 DIMENSION 111(1) RKTASA |          |
|-------------------------------------------------------------------------------------------------------------------------|----------|
|                                                                                                                         |          |
| 8 EQUIVALENCE(111(136),111) RKTASA 9 EQUIVALENCE(111(50),NM),(111(42),L),(111(16),J) RKTASA 10 EMTRY RKUITA RKIASA      |          |
| 11. T = TT<br>12 GO TO (10,40,140,250),L RKTASA 16-346-146-146-146-146-146-146-146-146-146-1                            | 2507     |
| 13. 10 16 = 16<br>14. 1F(16.60 2) 150,20 RKTA3A 26-                                                                     | <b>─</b> |
| 15. 20 00 30 I = 1, M RKTASA<br>16. K = 2*M + I RKTASA<br>17 30 F(K) = Y(I) RKTASA                                      |          |
| 18. L = 2 RKTA3A 19. 50 TO 270 RKTA3A                                                                                   | 270-     |
| 20. 40 T2 = TP - T<br>21                                                                                                |          |
| 22 56 [F(ABS(TZ/TP)-1 E=7) 130,60,60 RKTACA 66 130 RKTACA 66 130 RKTACA                                                 |          |
| 24 1F(TP.EQ.C.) 70,80 RKTA3A 7G 5G 125 TO 1F(H1-1 E-7) 130,80,80 RKTACA 2G 130                                          |          |
| 26. 80 IF(H1 - ABS(1.01+P 1)90,90,120 RKTACA 76-120                                                                     | 4 1      |
| 27. 90 IF(72)160,116,110 RKTACA 166-110-                                                                                |          |
| 28. 100 DT = -HL<br>29 GD TO 120 RKTACA 129-                                                                            |          |
| 30 110 DT = H1 RATASA 31 120 IG = 2 RATASA                                                                              |          |
| 32.                                                                                                                     | 150-     |
| 34. 130 T = TP RKTA3A                                                                                                   |          |
| 36. J = 1<br>37 GO TO 270 BKTA3A                                                                                        | 270-     |
| 38. 140 IG = 2 39. DT = P  RKTA3A RKTA3A                                                                                |          |
| 40. 150 DB 200 I = 1.N RKTASA<br>41 YK = DY(I)+DT RKTASA                                                                |          |
| 42 50 T0(160,170,170,180), J RKTASA 16G 170 180 43. 160 F(I) = YK RKTASA                                                |          |
| 44. GO TO 190 BKTA3A 190-                                                                                               |          |
| 46. GO TO 190 RKTA3A 190-                                                                                               | [ ]      |
| 48. 60 TD 200 RKTA3A 260-                                                                                               | <b> </b> |
| 49. 190 K = 2+N + I<br>50 Y(I) = F(K) + PR(J)+YK RKTA3A                                                                 |          |
| 51. 200 CONTINUE RKTA3A 210-230-                                                                                        |          |
| 53 210 T = T+TH(J)#0T RKTA3A S4 J = J + 1 RKTA3A                                                                        |          |
| 55. 220 L = 1 56. GD TD 270 RKTA3A                                                                                      | 270-     |
| 57. 236 DD 240 I = 1,N RETASA RETASA                                                                                    |          |
| 59. DELY(1) = F(1)/6. + DELY(1) 60. 240 Y(1) = F(M) + DELY(1) 65. RATASA 65. RATASA                                     | 1 1      |
| 61. 16 = 1<br>62                                                                                                        | 1        |
| 63 250 N = NN<br>64. PR(1)=PR(2)=TH(1)=TH(3)=.5 RKTASA                                                                  |          |
|                                                                                                                         |          |

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# SUBRØUT I NE RKTB3A

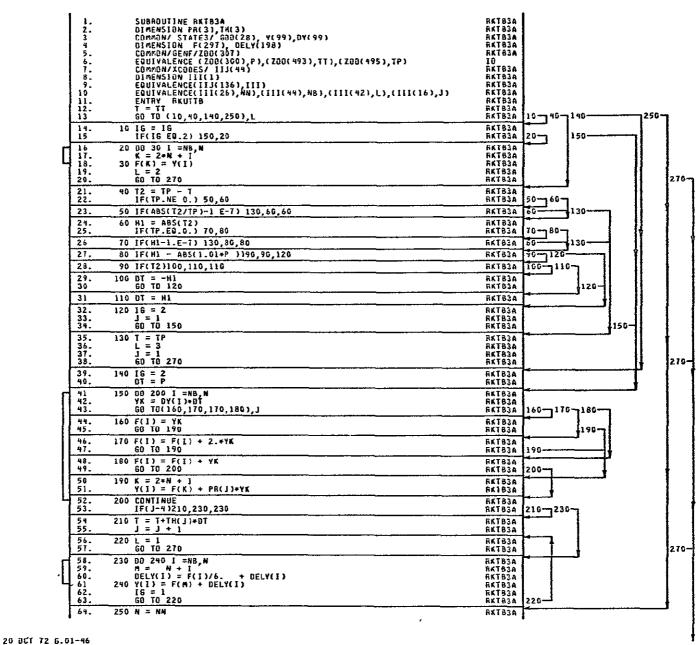
### Subroutine RKTB3A

# Entry Point RKUTTB

## Purpose

Subroutine RKTB3A is the utility RUNGE-KUTTA integration routine used for integrating the adjoint solution.

| FORTRAN | MATH   | CODE | DESCRIPTION                                                                                                          | STORA     |      | SUBBOUTINE USAGE                                                                                                                                     |                                                      |  |
|---------|--------|------|----------------------------------------------------------------------------------------------------------------------|-----------|------|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|--|
| SYMBOL  | SYMBOL | 4001 | DE SOUTE LION                                                                                                        | BLOLK     | LOL  | SUBR CODE                                                                                                                                            | VAR                                                  |  |
| DY      |        | I    | Array of derivatives for adjoint integration                                                                         | /51ATE3/( | 128) | ADEQ3A O<br>ADIC83 O<br>ADIC3A O<br>RKT83A I                                                                                                         | DVARL<br>DVARL<br>DVARL<br>DY                        |  |
| J       |        | M    | Integration routine flag tells which derivative evaluation in Runge-Kutta cycle                                      | /XCODES/( | 151) | ADIC3A M<br>BNTG I<br>MODELA I<br>PAYO2 M<br>RKTA3A M<br>RKTB3A M                                                                                    | 7<br>7<br>7<br>8<br>7<br>7<br>7<br>1<br>7            |  |
| Ĺ       |        | Ŋ    | Integration traffic control flag  L = 1 means evaluate derivatives  = 2 check cut-off  = 3 print or cut-off detected | /XCODES/( | 177) | OUT I<br>RKTA3A M                                                                                                                                    | L<br>L<br>L<br>L                                     |  |
| NB      |        | I    | Extent of integration set during adjoints on branch problem .                                                        | /XCOBES/( | 179) | ADEO3A I<br>ADICB3 M<br>ADIC3A M<br>BNTG O<br>BKTB3A I                                                                                               | NB<br>NB<br>NB<br>NB<br>NB                           |  |
| NW      |        | 1    | Number of integrated quantities during adjoint solution                                                              | /XCODES/( | 161) | ADIC3A M                                                                                                                                             | NEOB<br>NEOB<br>NN                                   |  |
| P       |        | 1    | Integration interval (SEC)                                                                                           | /GENF /(  | 300) | FNTG M<br>REU3 I<br>RKTA3A I<br>RKTB3A I<br>STP3 I                                                                                                   | BT<br>BT<br>BT<br>P<br>P<br>DT<br>DT                 |  |
| TP      |        | I    | Trajectory print time                                                                                                | /GENF /(  | 495) | FNIG M<br>RKTA3A I                                                                                                                                   | TIMPR<br>TIMPR<br>TP<br>TP                           |  |
| TT      | t      | M    | Time (elapsed) -                                                                                                     | /GENF /(  | 493) | ADICB3 O<br>AST3 I<br>BNTG M<br>CON3 I<br>DTF3 I<br>ENVPRM I<br>EQUA3 I<br>FNTG M<br>MODELA I<br>OUT I<br>PROPIN I<br>REU3 M<br>RKTASA M<br>RKTASA M | TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT               |  |
| ¥       |        | м    | Array of variables for adjoint integration                                                                           | /STATE3/( | 29)  | ADEQ3A I<br>ADICB3 Q<br>ADICB3 Q<br>PROPIN I<br>RKTA3A M<br>RKTB3A M<br>STVRL3 Q                                                                     | VARL<br>VARL<br>VARL<br>ZZ<br>F<br>Y<br>VARL<br>VARL |  |



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# SUBRØUT I NE SDER3

#### SDER3

### Entry Point SDER

## Purpose

Subroutine SDER3 computes the integrands of ideal velocity and velocity losses during the solution trajectory.



| FORTRAN<br>Symbol | MATH<br>Symbol         | CODE | DESCRIPTION                          | V              | <u>\$ T</u><br>BLQ(,) | ORA<br>K | GE<br>LOC | SUBROUTIN<br>SUBR COO                                                                                              | E USAGE<br>E VAR                                                  |
|-------------------|------------------------|------|--------------------------------------|----------------|-----------------------|----------|-----------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| AE                | A <sub>exit</sub>      | I    | Total nozzie exit area               |                | /GENF                 | /(       | 520)      | ACCEL I<br>FH2 I<br>IMPUL I<br>PROPB O<br>PROPIN O<br>SDER3 I                                                      | AE<br>AE<br>AE<br>AE<br>AE                                        |
| CODAE             | cos(α-δ <sub>E</sub> ) | I    | See symbol                           |                | /GENF                 | **       | 549)      | ACCEL I<br>BL4 I<br>BL6 I<br>BL7 I<br>BL8 I<br>FH3 I<br>SDER3 I<br>VT 0                                            | CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE       |
| DB                | D <sub>b</sub>         | 1    | Base drag                            | (LBS)          | /GENF                 | /(       | 537)      | ACCEL 1<br>BL4 I<br>BL6 1<br>BL7 I<br>BL8 I<br>EQUA3 I<br>FH3 I<br>OUT I<br>SDER3 I<br>VT I                        | 08<br>08<br>08<br>08<br>08<br>08<br>08<br>08                      |
| DRAG              | О                      | 1    | Aerodynamic drag                     | (LBS)          | /GENF                 | /(       | 497)      | ACCEL I<br>BL5 I<br>BL7 I<br>BL8 I<br>ENVPRM I<br>FH3 I<br>OUT I<br>PROPB O<br>PROPIN O<br>SDER3 I                 | BRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>D |
| DVAR              | ÿ                      | 0    | State vector derivatives in steepest | descent madule | /STATE                | 3/(      | 15)       | ADICBS M ADICSA I ADIDSA M OERSA O DTFS I ENVPRM I PDBC I PROPIN D REUS I RKTASA I SDERS O STPS I YREFS I          | DVAR<br>DVAR<br>DVAR<br>VD<br>VAR<br>DVAR<br>DVAR<br>DVAR<br>DVA  |
| FVAC              |                        | I    | Total vacuum thrust [rocket]         | (LBS)          | /GENF                 | /(       | 528)      |                                                                                                                    | FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC<br>FVAC                      |
| 6                 | g                      | I    | Gravitational attraction             | (FT/SEC++2)    | / GENF                | /(       | 301)      | BL4 I<br>BL7 I<br>BL8 I<br>DER3A I<br>EQUA3 M<br>MODELA I<br>MODELA I<br>MODELA I<br>FDY3A I<br>SDER3 I<br>SDINP M | 6866666666                                                        |

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| FORTHAN<br>Symbol | MAIH<br>Symbol | 1000 | DESCRIPTION                 |       | S 1 OR A  | LOC  | SUBHOUTINE USAGE<br>SUBR CODE VAR                                                                                                                                                                                                                         |
|-------------------|----------------|------|-----------------------------|-------|-----------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| M                 | n              | 1    | Mass                        |       | /5TATE3/( | 43   | ACCEL I M<br>BL4 I M<br>BL8 I M<br>EQUA3 I M<br>DUT I M<br>SDER3 I M                                                                                                                                                                                      |
| NEQ               |                | I    | Number of integrated states |       | /XCODES/( | 162) | ADICB3 I NEQ<br>ADIC3A I NEQ<br>ADID3A F NEQ<br>ADID3A F NEQ<br>AST3- I NEQ<br>BGET3 I NEQ<br>BST03 I NEQ<br>BTX3A I NEQ<br>OUT I NEQ<br>OUT I NEQ<br>SDER3 I NEQ<br>SDER3 I NEQ<br>SDINP M NEQ<br>TOPM I NEQ<br>TOPM I NEQ<br>TRAN3 I NEQ<br>YREF3 I NEQ |
| PA                | р <sub>а</sub> | I    | Atmospheric pressure        | (PSF) | /GENF /(  | 308) | EQUAS M DZM<br>FH2 I PA<br>IMPUL I PA<br>OUT I PA<br>POBC I PA<br>SDER3 I PA                                                                                                                                                                              |
| SINGAM            | sin(γ)         | I    | See symbol                  |       | /STATE3/( | 688) | BL4 I SINGAM<br>BL7 I SINGAM<br>BL8 I SINGAM<br>DER3A I SINGAM<br>MODELA I SINGAM<br>MODELA I SINGAM<br>MODELB I SINGAM<br>PDBC I SINGAM<br>PDBC I SINGAM<br>SINGAM<br>SINGAM                                                                             |
| Ţ                 | T              | 1    | Thrust                      | (LBS) | /GENF /(  | 411) | ACCEL I T BLGCON M T BL4 I T BL6 I T BL7 I T BL8 I: T EL2 I T EQUAS O T FH1 I T FH2 I T FH4 I T IMPUL I T OUT I T PROPIN O T REUS O T SDERS I T                                                                                                           |

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SUBROUTINE SDER3
  SOER3
COMN
COMN
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STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
STATE30
  1.
2
3
4.
5.
6.
7.
   INTEGRANDS
                               IDEAL VELOCITY AND VELOCITY LOSS
                      ,SVY(10)
,SAVBP(15)
,OCORO2
8.
9.
  , oov
   ,00G
,00R
,V0P
,GDO
1123456789012345678901
  STATESD
STATESD
STS
STS
STS
ARCDAT
                       COMMON/515/

#PPAY , PMIN , WORK (20), NWDS , IPC (7), NITER

#MNGA(26,2), MNGP(20,2) , AR(200), IAD(20) , INP(20), ISV(20)

CD mmON/ARCOAT/
  XISP
JAER
GMDOT
MAED
MXCG
ZCGR
RHOB
  ,TMULT
,JPRO
,ALFMAX
,MAEE
,MZCG
,XE
,QMULT
  DTNC
QMAX
PHMAX
MAEF
MWDA
ZE
REMAX
                      OTPI
GMAX
MAEA
MAEG
MWDB
  ARCDAT
ARCDAT
ARCDAT
ARCDAT
  ARCDAT
ARCDAT
ARCDAT
RETAP
ARCDAT
                     ARCDAT
ARCD3
AECD3
32345.355.355.412.
   ,GDA
,PHI
,XLAMP(9)
,ZCGM
,CMOM
  ,ALPHA
,PHIO
,PDPH
,FK
,CMAM ,CMM
,GLA
,CDM
  VDA
PHID
XLAMA(9)
XCGM
CMO
CLM
   ,PDA
,SINPHI
,CDO
,CLOM
,FKM
   ,TOL(9)
,COT1(9,9)
,OPSQ
,PA
,CSR
,TOP
,DIP(20)
,DIS1(20)
,TAX
,FPD
,LIFTV
DRAGV
,DB
  WDC(20)
OTP
QS
CS
SUMSQ
TR(9)
W
OMP
TBU(20)
MACHY
  SVAR(10)
DCON(9)
RO
  SENF
GENF
GENF
GENF
GENF
4444445555555555566666666670
  VNR
TOS
TIME
TBURN
MACHR
   GENF
GENF
   . DRAGR
  DRAGA
,15PF
,ULFTA
  LIFTA
                       +LIFTR
   SENF
  DBR
ULFT
XMCGR
CALPHA
XCG
   DRAGV
DB
ULFTV
XMCGA
CDE
ZCG
   ISP
ULFTR
XMCGM
                     *XMC6
   . XMCGV
  GENF
GENF
GENF
  , CODAE
   GENF
GENF
   GENF
   GENF
GENF
   GENF
GENF
   FRAT
71
72
73
74
75
   GENF
GENF
EQUV3
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```
EQUY3
EQUY3
ELOBAL
GLOBAL
GLOBAL
GLOBAL
RETAP
XCODES
XCODES
    7778012345678890123456788888888999999999999111000000111110000
   JGID(20,2), JPH (20,2),
NSAB NICNB
IFB IND
IARC ISTART
JPS JS
NAO NCASE
NPH N
IFTH ISTAB
ISTAPP L
NPHP NPHB
   XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
  SDEHS
AAA
COMN
PH1SZ
COMN
SDERS
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SDERS
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SDER3
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# SUBRØUT I NE SDINP

#### SDINP

### Purpose

SDINP scans and interprets input data.

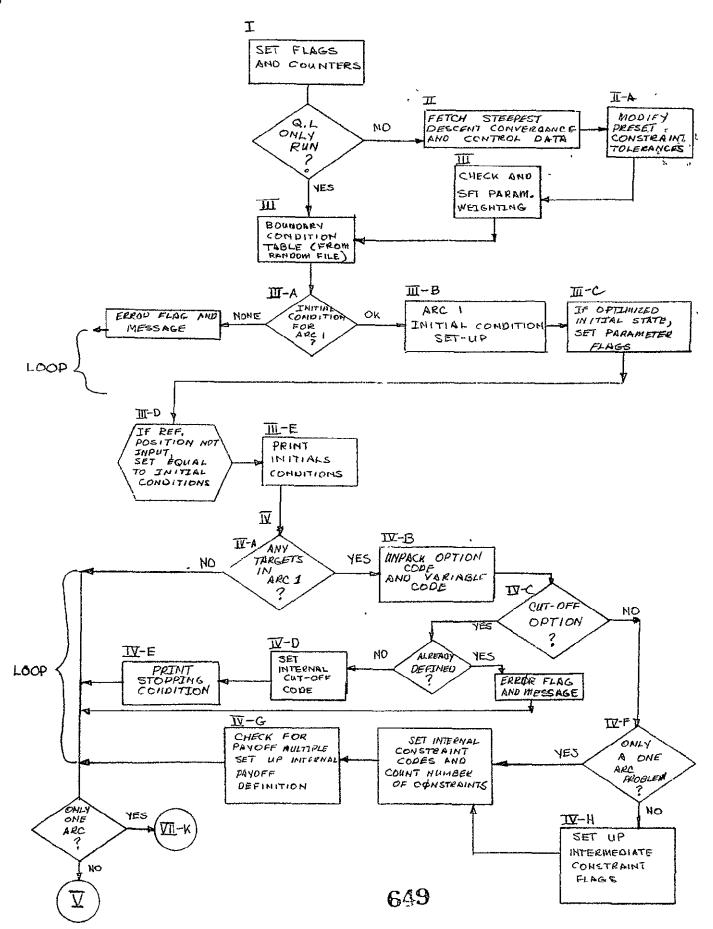
### Description

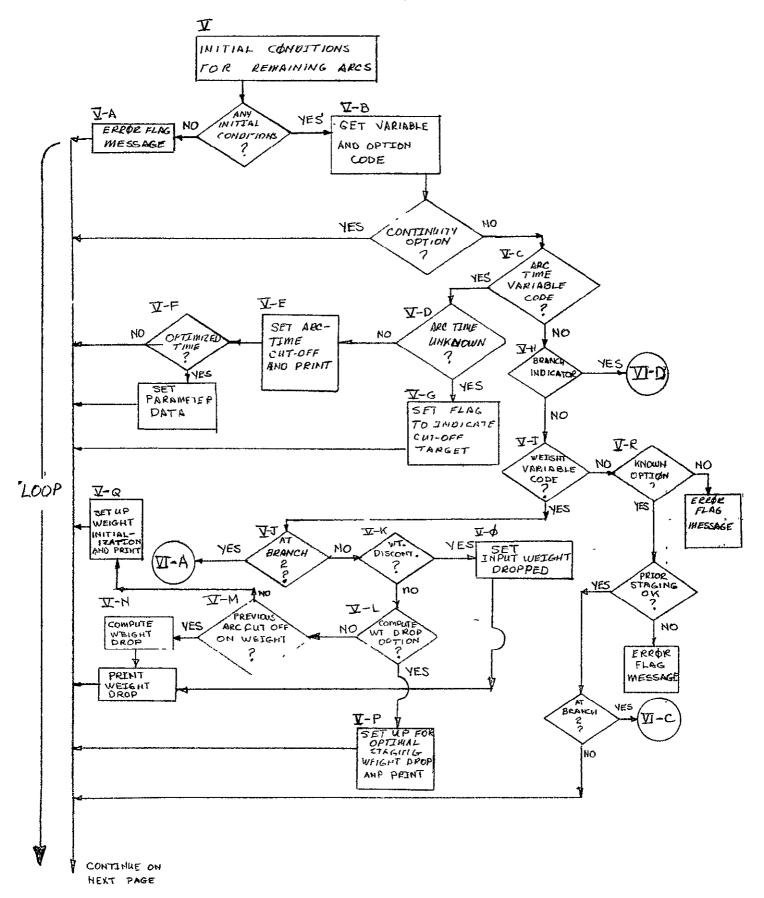
SDINP is an overlay called by the Steepest Descent executive routine, TOPM. The bulk of its coding is related to converting input data into internally used data and flags for the steepest descent module; however, it serves also to check boundary condition data for the quasi-linearization module and print out this data.

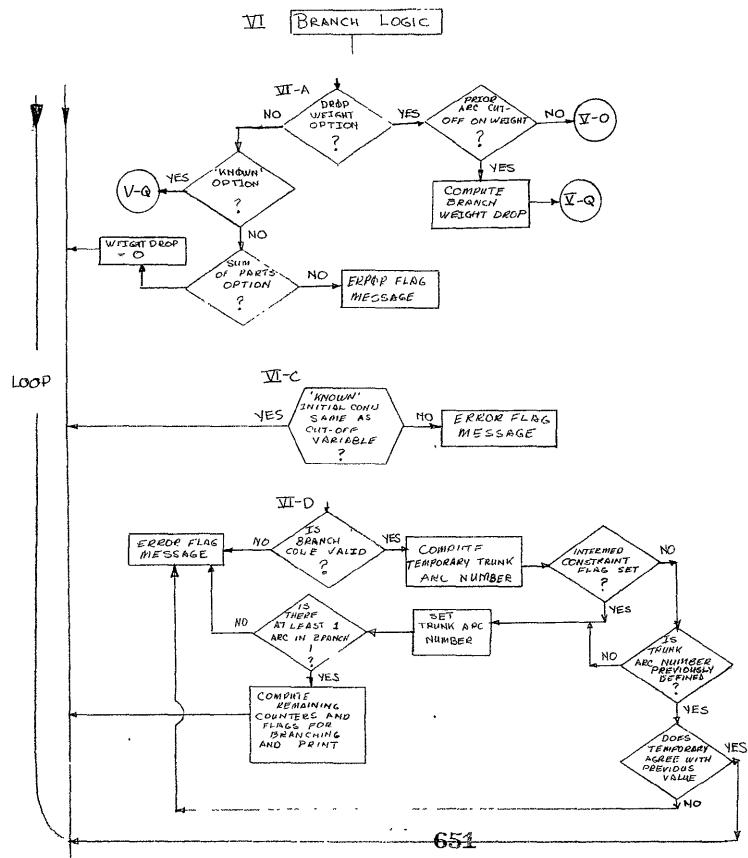
Aside from boundary condition data, SDINP processes the following type of data for the Steepest Descent program.

- 1. Updates of present constraint tolerances and parameter weighting factors
- 2. Tape starting solution initialization.
- 3. Solution control modes
- 4. Starting nominal control modes and tables (no tape solution given)
- 5. Steepest descent convergance data
- 6. Steepest descent storage flags and counters.

## SDINP

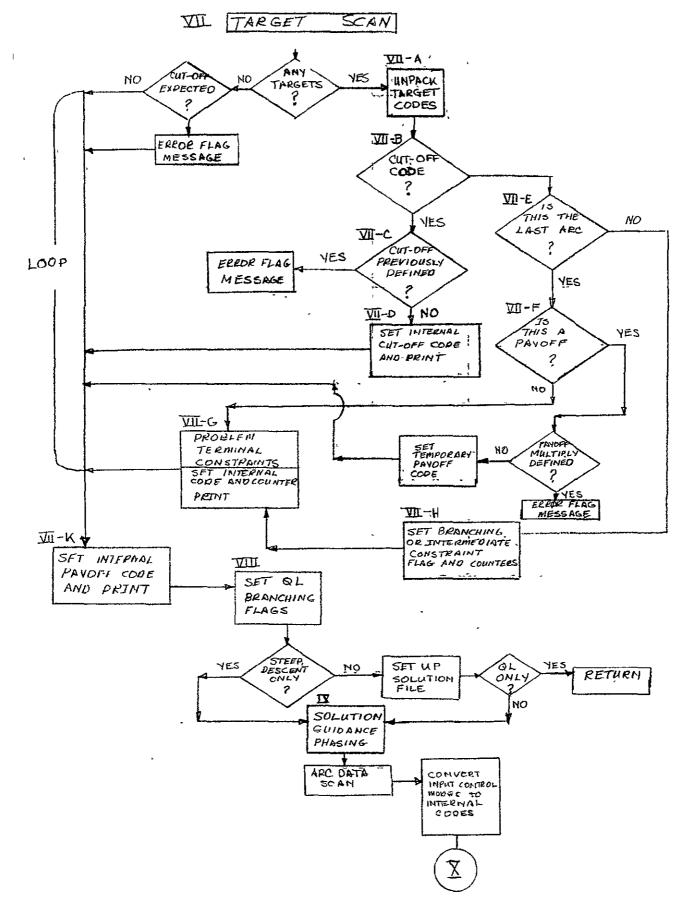


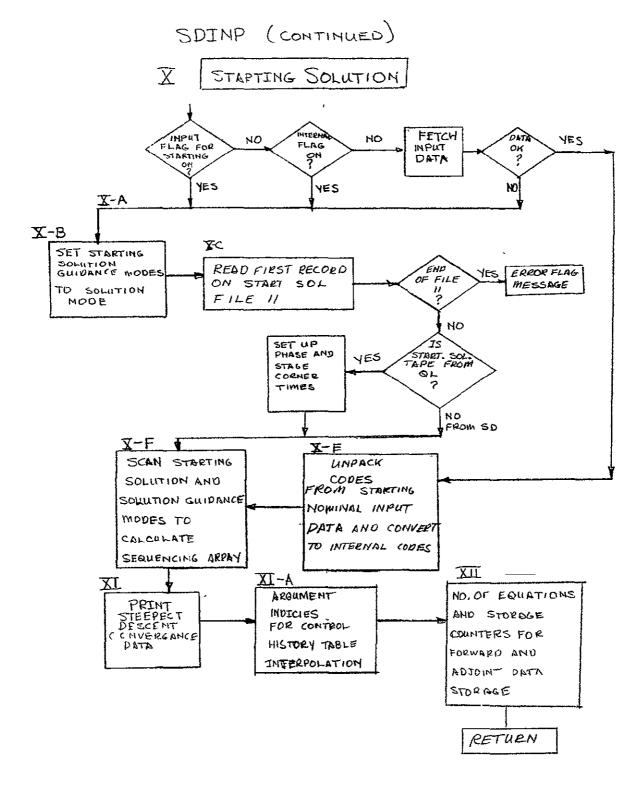




SDIMP (CONTINUED)

## SDINP (CONTINUED)





| FORTRAN<br>Symbol | MATH<br>Symbol   | CODE    | DESCRIPTION                       |                                        | ST<br>BLOCK | ORAG | E<br>LOC | SUBROU<br>SUBR                                                                              |                                 | E USAGE                                                                    |
|-------------------|------------------|---------|-----------------------------------|----------------------------------------|-------------|------|----------|---------------------------------------------------------------------------------------------|---------------------------------|----------------------------------------------------------------------------|
| A                 | A                | I Contr | ol integral matrix                | ······································ | /GENF       | /(   | 109)     | ADEQ3A<br>ADICB3<br>BGET3                                                                   |                                 | A<br>A<br>A                                                                |
|                   |                  |         |                                   |                                        |             |      |          | BNTG<br>BST03<br>MTX3A<br>PAY02<br>SOINP<br>TRAN3                                           | I                               | A<br>A<br>A<br>A<br>A                                                      |
| AR                |                  | I Array | for storing starting control his  | tory tables                            | /\$T\$      | /(   | 112)     | SDINP<br>SDINP<br>TBLK                                                                      | I<br>I<br>I                     | AR<br>III<br>AR                                                            |
| ARCDA             | S <sub>ref</sub> | I Aeroo | lynamıc reference arem            | (F1 <sup>2</sup> )                     | / ARCBA     | Τ/(  | 1)       | BNTG<br>EQUAS<br>FNTG<br>FXDAT<br>FXDAT<br>GEINP<br>SDINP<br>SIZIN<br>SIZIN<br>THRUST<br>VT | I<br>I<br>I<br>I<br>I<br>I<br>I | ARCDA<br>SREF<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>SREF<br>SREF |
| BNARR             |                  | I Packe | d boundary condition array.       |                                        | /SDINP      | /(+  | )        | SDINP                                                                                       | I                               | BNARR                                                                      |
| DELP              |                  | 0 Input | or preset nominal parameter adju  | stment size                            | /PARAM      | 70   | 357)     | SDINP<br>Topm                                                                               | 0<br>D                          | DELP<br>DELP                                                               |
| DIP1              |                  | n Phase | initial times for nominal trajec  | tory [sd]                              | /GENF       | /{   | 453)     | GETIT<br>SDINP<br>TEST<br>TOPM                                                              | I<br>M<br>0<br>I                | DIP1<br>DIP1<br>DIP1<br>DIP1                                               |
| DISI              |                  | M Arc i | nîtîal tiwes for nominal trajecto | ry [sd]                                | /GENF       | /(   | 473)     | GETIT<br>SDINP<br>TEST<br>TOPM<br>TRAN3                                                     | I<br>M<br>O<br>I<br>I           | DIS1<br>DIS1<br>DIS1<br>DIS1<br>DIS1                                       |
| DPAY              | d∳               | I Insti | al payoff improvement             |                                        | /STS        | /(   | 1)       | PAYO2<br>SDINP<br>SDINP<br>SDINP<br>TEST<br>TOPM                                            | I<br>0<br>I<br>I                | DPAY<br>DPAY<br>IST<br>ST<br>DPAY<br>IDPAY                                 |
| G                 | g                | M Gravi | tations  attraction               | (FT/\$EC**2)                           | /GENF       | R    | 301)     | BL4<br>BL7<br>BL8<br>DER3A<br>EQUA3<br>MODELA<br>MODELA<br>PDY3A<br>SDER3<br>SDINP          | I<br>I<br>I<br>I<br>I<br>I<br>I |                                                                            |

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE     | DESCRIPTION                                                                                        | BLOCK     | GE<br>LOC                             | SUBROUTIN<br>SUBR COD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | E USAGE<br>E VAR                                             |
|-------------------|----------------|----------|----------------------------------------------------------------------------------------------------|-----------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| <del></del>       |                |          |                                                                                                    |           | · · · · · · · · · · · · · · · · · · · |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                              |
| GR                | 9.             | 1 6      | Gravitational acceleration at surface of the earth<br>(FT/SEC <sup>2</sup> )                       | /GLOBAL/( | 1)                                    | ACCEL I<br>BL5 I<br>EQUAS I<br>FH3 I<br>GEINP I<br>GEINP I<br>OUT I<br>PADS1 I<br>PADS1 I<br>PADS1 I<br>SOINP I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZE I<br>SSIZ | GRRR R GRRRRRRRRRRRRRRRRRRRRRRRRRRRRRR                       |
| IAD               |                | m s      | tarting address of each control history table                                                      | /\$T\$ /( | 312)                                  | SDINP M<br>TBLK I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | IAD<br>IAD                                                   |
| IARC              |                | M A      | rc number                                                                                          | /xcodes/( | 146)                                  | ADICB3 I ADID3A I ADID3A I ADJUST I AST3 M ENVPRM I FNTG M GETIT I PROPB I PROPB I PROPB I PROPIN I SDINP M STAM I TRTOS Z I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | IARC<br>IARC<br>IARC<br>IARC<br>IARC<br>IARC<br>IARC<br>IARC |
| ICOR              |                | W P      | hase requence array                                                                                | /xcobes/( | 10)                                   | ADJUST I<br>FNTG I<br>PRMSET I<br>SDINP M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ICOR<br>ICOR<br>ICOR<br>ICOR                                 |
| 10                |                | г        | four word array containing the basic deck, eference run, case and part case numbers in that -rder. | /GLOBAL/( | 21)                                   | BLICO I<br>FRENCH I<br>GEINP I<br>PADS1 D<br>PRINT I<br>SDINP I<br>TOPM I<br>VEHDF I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 10<br>10<br>10<br>10<br>10<br>10                             |
| IFATAL            |                | МF       | atal error flag.                                                                                   | /SLOBAL/( | 17)                                   | BLICO M<br>GEINP O<br>PADS1 I<br>SOINP M<br>SPLICO M<br>STPIT U<br>TOPM M                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | IFATAL IFATAL IFATAL IFATAL IFATAL IFATAL IFATAL             |
| 111               |                | I A      | rray for storing starting control history tables                                                   | /ST\$ /(  | 112)                                  | SDINP I<br>SDINP I<br>TBLK I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | AR<br>III<br>AR                                              |
| IMODE             |                | I C      | ontrol mode option flag                                                                            | /ARCBAT/( | 8)                                    | FXDAT M<br>SDINP I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | IMODE<br>IMODE                                               |
| I NP              |                | m I<br>t | ndex of last argument of each control history<br>able                                              | /ST\$ /(  | 332)                                  | SDINP M<br>TBLK I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | INP<br>INP                                                   |

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| FORTHAN<br>SYMBOL | MATH<br>Symbol | CODE | DESCRIPTION                                                                                                                             | BLOLK     | LOC  | SUBROUTING<br>SUBR CODE                                                               |                                                    |
|-------------------|----------------|------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------|------|---------------------------------------------------------------------------------------|----------------------------------------------------|
| INTB              |                | M    | Branching and intermediate constraint flag                                                                                              | /XCODES/( | 31,) | ADIC3A I<br>BNTG I<br>ENVPRM I,<br>FNTG I<br>SDINP M<br>TEST I<br>TRAN3 I<br>TRTOSZ I | ETNIB<br>BINIB<br>BINIB<br>BINIB<br>BINIB<br>BINIB |
| HAI               |                | Ħ    | Phase number                                                                                                                            | /xcddes/e |      | ADID3A I<br>ADJ05T I<br>AST3 I<br>BNTG M<br>FNTG M<br>GETIT I<br>GUI3A I<br>SDINP M   | IPH IPH IPH IPH IPH IPH IPH IPH IPH                |
| IPDINT            |                | 0    | Code for each adjustable parameter in steepest descent.                                                                                 | /PARAM /( | 1)   | ADJUST I<br>PRMSET I<br>SOINP O<br>STAU I<br>TOPM D                                   | IPDINT<br>IPDINT<br>IPDINT<br>IPDINT<br>IPDINT     |
| IST               | d∳             | 0    | Inîtîal payoff ımprovement                                                                                                              | /STS /(   | 13   | PAYO2 I<br>SDINP I<br>SDINP O<br>SDINP I<br>TEST I<br>TOPM D                          | DPAY<br>DPAY<br>IST<br>ST<br>DPAY<br>IDPAY         |
| ISV               |                | 0    | Saved index of last control history table look-up                                                                                       | /STS /(   | 352) | SDINP O<br>TBLK M                                                                     | ISV<br>ISV                                         |
| ITAB              |                | I    | A 20 word array containing the number of nonzero state initial conditions specified at the beginning of each subarc                     | /GLOBAL/( | 45)  | GEINP 'I<br>SDINP I<br>SIZIN I                                                        | ITAB<br>ITAB<br>ITAB                               |
| 171               |                | 0    | Optimized arc time flag                                                                                                                 | /XCODES/( | 30)  | ADJUST M<br>FNTG 1<br>SDINP 0                                                         | ITI<br>ITI<br>ITI                                  |
| ITP\$0            |                | ī    | A non zero input value indicates to the steepest descent module that the initial steering angle profiles are stored on logical unit 11. | /GLOBAL/( | 93)  | SDINP I                                                                               | ITP50                                              |
| ITQ               |                | M    | Constraint option-code (internal)                                                                                                       | /xcobes/( | 1)   | ADICB3 I<br>ADIC3A I<br>ADID3A I<br>CON3 I<br>SDINP M<br>STAU I<br>TOPM D             | 1TQ<br>1TO<br>1TO<br>1TO<br>1TO<br>1TO             |
| J G I D           |                | P    | Control option flag array                                                                                                               | /XCODES/( | 32)  | BNTG I<br>FNTG I<br>SDINP M                                                           | JGID<br>JGID                                       |
| <i>≯</i> H9L      |                | Fi   | Phase cut-off option flag                                                                                                               | /XCODES/( | 72)  | BNTG I<br>FNTG M<br>SDINP M                                                           | JPH<br>JPH<br>JPH                                  |
| JST               |                | M    | Arc cut-off option flag                                                                                                                 | /XC00ES/( | 112) |                                                                                       | JST<br>JST<br>JST<br>JST                           |
| К                 |                | M    | Storage retrieval flag indicates end of arc, phase, or data.                                                                            | /XCODES/( | 156) |                                                                                       | K<br>K<br>K<br>K                                   |
| KSOL              |                | M    | An internal flag that has the same significance as ITPSO.                                                                               | /GLOBAL/( | 94)  | FNTG I<br>PAOS1 O<br>SDINP M                                                          | KSOL<br>KSOL<br>KSOL                               |
| KTAB              |                | 1    | A 20 word array containing the number of state target conditions specified at the end of each subarc.                                   | /GLOBAL/( | 25)  | GEINP I<br>SDINP I<br>SIZIN I                                                         | KTAB<br>KTAB<br>KTAB                               |
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| FORTRAN | MATH           | CODE DECEDIETION                                                                                                                                                                   | STORAGE           | <u>SUBROUTINE USAGE</u>                                                                                                                                                                           |
|---------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL         | CODE DESCRIPTION                                                                                                                                                                   | BLOCK LOC         | SUBH CODE VAR                                                                                                                                                                                     |
|         |                | M Integration traffic control flag L = 1 means evaluate derivatives = 2 check cut-off = 3 print or cut-off detected                                                                | /xcobes/c 177     | ) BATG M L<br>FATG M L<br>OUT I L<br>RKTA3A M L<br>RKTB3A M L<br>SDINP M L                                                                                                                        |
| LUM     |                | I Program control flag.  LUM = 0 Steepest descent only,  LUM = 1. Steepest descent and adjoint  transformation stored on tape,  LUM = 2 Steepest descent and QL;  LUM = 3 QL only. | /GLOBAL/( 6       | ) AST3 I LUM<br>FNTG I LUM<br>GEINP I LUM<br>PADS1 M LUM<br>SDINP I LUM<br>TOPM M LUM                                                                                                             |
| MIXA .  | •              | I Maximum number of words in trajectory data buffo<br>990.                                                                                                                         | er = /RETREV/( 12 | ) AGETB3 I MIXA<br>AST3 I MIXA<br>SDINP I MIXA<br>TOPM D MIXA                                                                                                                                     |
| MIXB    |                | I Maximum number of words in adjoint data buffer a 3000.                                                                                                                           | = /RETREV/( 13    | ) BGET3 I MIXB<br>BST03 I MIXB<br>SDINP I MIXB<br>TOPM D MIXB                                                                                                                                     |
| MNGA    |                | M Control history curve number                                                                                                                                                     | /STS /( 32        | ) GUISA M MNGA<br>SDINP M MNGA<br>SDINP I TAL                                                                                                                                                     |
| MNGP    |                | M Control history curve number                                                                                                                                                     | /515 /( 72        | ) GUI3A M MNSP<br>SDINP M MNSP<br>SDINP I WTPI                                                                                                                                                    |
| MXA     |                | O Index of last stored word in full buffer of form trajectory data.                                                                                                                | ward /RETREV/( 14 | ) AGETB3 I MXA<br>AST3 I MXA<br>SDINP 0 MXA                                                                                                                                                       |
| MXB     |                | O Index of last stored word in full buffer of adjudate.                                                                                                                            | oint /RETREV/( 15 | ) BGET3 I MXB<br>BST03 I MXB<br>SDINP 0 MXB                                                                                                                                                       |
| NARC    | N <sub>3</sub> | I Number of subarcs in the problem.                                                                                                                                                | /GLOBAL/( 18      | ) FNTG I NARC<br>GEINP M NARC<br>PROPIN I NARC<br>SDINP I NARC<br>SIZIN I NARC                                                                                                                    |
| NBRAN   | N I            | O Number of the last subarc on the stem of a branc<br>problem. If the problem is not a branch problem<br>then NBRAN = O.                                                           |                   | ) SDINP O NBRAN                                                                                                                                                                                   |
| NCNST   | n              | កា Number of problem constraints                                                                                                                                                   | /xcodes/c 132     | ) BGET3 I NCNST<br>BST03 I NCNST<br>CDN3 I NCNST<br>PAY02 I NCNST<br>SDINP M NCNST<br>SUMS I NCNST<br>TEST I NCNST<br>TOPM I NCNST<br>TRAN3 I NCNST                                               |
| NEQ     |                | M Number of integrated states                                                                                                                                                      | /XCODES/( 162     | ) ADICB3 I NEO ADIC3A I NEO ADIC3A I NEO ADIC3A I NEO AST3 I NEO AST3 I NEO BST03 I NEO MTX3A I NEO TOPA I NEO SDER3 I NEO SDER3 I NEO SDER3 I NEO SDINP M NEO TOPA I NEO YREF3 I NEO YREF3 I NEO |

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| FORTRAN | MATH           | CODE | DESCRIPTION                                                                                                     | STORA     |      | SUPROU                                                                              |                            |                                                                                                 |
|---------|----------------|------|-----------------------------------------------------------------------------------------------------------------|-----------|------|-------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL         | COUE | DESCRIPTION                                                                                                     | BLOCK     | LUL  | SUBR                                                                                | CODE                       | VAR                                                                                             |
| NEOF    | ٠              | 0    | Number of equations to be integrated on forward trajectory                                                      | /XCODES/( | 185) | REU3<br>RKTA3A<br>SDINP<br>STAU<br>TOPM<br>TRAN3                                    | 0                          | NEOF<br>NO<br>NEOF<br>NEOF<br>NEOF<br>NEOF                                                      |
| NFARC   | N <sub>2</sub> | 0    | Number of the last subarc on the first branch. If<br>the problem is not a branch problem, then NFARC =<br>NARC. | /GLOBAL/( | 20)  | SDINP                                                                               | 0                          | NFARC                                                                                           |
| NICNB   |                | M    | Number of constraints at intermediate constraint point or at end of first branch                                | /XCODES/( | 135) | ADICB3<br>ADIC3A<br>BNTG<br>REU3<br>SDINP<br>TEST<br>TRAN3                          | I<br>I<br>I                | NICNB<br>NICNB<br>NICNB<br>NICNB<br>NICNB<br>NICNB<br>NICNB                                     |
| NITER   |                | I    | Maximum number of steepest descent iterations                                                                   | /STS /(   | 31)  | SDINP<br>TEST                                                                       | I<br>I                     | NITER<br>NITER                                                                                  |
| NP AR A |                | M    | Number of adjustable parameters in trajectory problem.                                                          | /PARAM /( | 13)  | ADJUST<br>BNTG<br>FNTG<br>MTX3A<br>PAYD2<br>PRMSET<br>SDINP<br>STAU<br>TEST<br>TOPM | I<br>I<br>I<br>I<br>M<br>I | NP AR A<br>NP AR A |
| NP H    |                | M    | Number of phases in trajectory                                                                                  | /xcodes/( | 164) | BNTS<br>FNTS<br>PRMSET<br>SDINP<br>TEST<br>TOPM                                     |                            | NPH<br>NPH<br>NPH<br>NPH<br>NPH<br>NPH                                                          |
| NPTA    |                | M    | Number of words stored at each trajectory time point.                                                           | /RETREV/( | 16)  | SDINP                                                                               | M                          | NPTA                                                                                            |
| NPTB    |                | M    | Number of words stored at each adjoint solution<br>time point.                                                  | /RETREV/C | 17)  | BGET3<br>SDINP                                                                      | I<br>M                     | NPTB<br>NPTB                                                                                    |
| NS      |                | I    | Number of arcs in trajectory                                                                                    | /XCODES/( | 166) | BNTG<br>FNTG<br>PROPB<br>SDINP<br>SDINP<br>TEST<br>TOPM<br>TRAN3                    | I<br>I<br>M<br>I<br>I      | NST<br>NST<br>NS<br>NST<br>NST<br>NST<br>NST<br>NST                                             |
| NSAB    |                | ri.  | Number of arcs on first branch                                                                                  | /xcobes/( | 134) | ADICB3 BNTG ENVPRM FNTG SDINP TEST TRAN3 TRIOSZ                                     | I<br>I<br>M<br>I<br>I      | NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB                                    |
| NSB     |                | Ħ    | Number of arcs prior to branch point or intermediate constraint                                                 | /xcodes/( | 133) | ADICB3<br>BNTG<br>ENVPRM<br>FNTG<br>REU3<br>SDINP<br>TEST                           | I<br>I<br>I<br>I<br>M<br>1 | NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB                                     |

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| FORTRAN      | HIAM               | CODE                                | DESCRIPTION                                       |           | STORA<br>BLULK | GE<br>LOC | SUBBOUTI<br>SUBB CO                                                                                                                |                                                                               |
|--------------|--------------------|-------------------------------------|---------------------------------------------------|-----------|----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| SYMBOL       | SYMBOL             |                                     |                                                   | <u> </u>  | OCUUN          |           | SUOR CU                                                                                                                            | UE AHL                                                                        |
| NST          |                    | n Number of ar                      | cs In trajectory                                  |           | /XC0DE\$/(     | 166)      | BNTG I<br>FNTG O<br>PROPB I<br>SDINP M<br>SDINP M<br>TEST 1<br>TOPM I<br>TRAN3 I                                                   | NST<br>NST<br>NST<br>NS<br>NST<br>NST<br>NST<br>NST                           |
| OMG          | $\Omega_{J}$       | M Array of arc                      | cut off values [sd]                               |           | /GENF /(       | 1)        | ADJUST M<br>FNTG I<br>PRMSET M<br>PROPB I<br>SOINP M<br>STP3 I<br>TOPM O                                                           | OMG<br>OMG<br>OMG                                                             |
| OMGP         |                    | M Array of phas                     | se cut off values [sd]                            |           | /GENF /(       | 21)       | ADJUST OF FNTG MPRMSET OF SOINP M                                                                                                  | OMGP<br>OMGP<br>OMGP<br>OMGP                                                  |
| OMGZ         | ω                  | I Earth rotatio                     | on rate                                           | (RAD/SEC) | /GLOBAL/(      | 3)        | ADID3A I<br>CRASH I<br>DER3A I<br>EQUAS I<br>MODELA I<br>MODELB I<br>PDBC I<br>PDBC I<br>PDBC I<br>PDBC I<br>PDBC I<br>TOPM I      | OMGZ<br>OMEGA<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ<br>OMGZ |
| PMIN         |                    | I Minimum payor                     | ff improvement                                    |           | /STS /(        | 2)        | PAYO2 I<br>SDINP I<br>TEST I                                                                                                       | PMIN<br>PMIN<br>PMIN                                                          |
| PSIRF        | $\psi_{_{\Gamma}}$ | M Reference azi                     | imuth.                                            | (DEG)     | /GLOBAL/(      | 68)       | GEINP I<br>REU3 I<br>SDINP M                                                                                                       | PSIRF<br>PSIRF<br>PSIRF                                                       |
| RAD          |                    | I Radian to ang                     | gle conversion, 57.29577951                       |           | /DATA /(       | 2)        | BEROCO I<br>BLGCON I<br>ENVPRM I<br>EQUAS I<br>FNIG I<br>GUISA I<br>MODELA I<br>MIXSA I<br>OUT I<br>PADSI D<br>SDINP I<br>TRIOSZ I | DEG<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD<br>RAD     |
| ROI          |                    | I Angle to radi                     | ian conversion, .01745329252                      |           | /OATA /(       | 3)        | BLICD I<br>DERSA I<br>FNTG I<br>GUISA I<br>MODELA I<br>MODELB I<br>PADSI D<br>PROPIN I<br>REUS I<br>SDINP I<br>SOMG I              | RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI<br>RDI            |
| \$1 <b>G</b> |                    | M Payoff sign<br>SIG < 0<br>SIG > 0 | Payoff to be minimized,<br>Payoff to be maximized |           | /GLOBAL/(      | 65)       | PAYO2 I<br>SDINP M<br>TEST I<br>TRAN3 I                                                                                            | S16<br>S16<br>S16<br>S16                                                      |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                                                           |       | STOR<br>BLUCK | ARE<br>LOC | <u> </u>                                                                    |                       | USAGE<br>VAR                                                 |
|-------------------|----------------|------|---------------------------------------------------------------------------------------|-------|---------------|------------|-----------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------|
| ST                | d∳             | I    | Initial payoff improvement                                                            |       | /STS /        | ( 1)       | PAYO2<br>SDINP<br>SOINP<br>SDINP<br>TEST<br>TOPM                            | 1<br>1<br>0<br>1<br>1 | DPAY<br>DPAY<br>IST<br>ST<br>DPAY<br>IDPAY                   |
| SVAR              | y   t=0        | M    | Array of state values at initial problem time [                                       | sd]   | /GENF /       | ( 79)      | ADJUST<br>BNTG<br>FNTG<br>PRMSET<br>REU3<br>SDINP<br>TEST<br>TOPM<br>TRTOSZ | I<br>M<br>I<br>M<br>I | SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR |
| TAL               |                | I    | Control history curve number                                                          |       | /STS /        | ( 32)      | GUI3A<br>SDINP<br>SDINP                                                     | M<br>M<br>I           | MNGA<br>MNGA<br>Tal                                          |
| TARG<br>Tinit     | 4              | 1    | Target condition part of BNARR.  Trajectory start time. (                             | SEC.) | /SDINP /      |            | SDINP                                                                       | I<br>O                | TARS<br>TINIT                                                |
| TOL               | <sup>†</sup> o | M.   | Tolerence on constraint misses [sd]                                                   | 0207  | /GENF /       |            | SDINP<br>SUMS<br>TEST                                                       | M<br>I<br>I           | TOL<br>TOL<br>TOL                                            |
| TPH1              |                | 0    | Phase end times for nominal trajectory                                                |       | /GENF /       | ( 413)     | BNTG<br>GETIT<br>SDINP<br>TEST<br>TOPM                                      | I<br>0<br>0           | TPH1<br>TPH1<br>TPH1<br>TPH1<br>TPH1                         |
| TST1              |                | 0    | Arc end times for nominal trajectory                                                  |       | /GENF /       | ( 433)     | BNTG<br>GETIT<br>PROPIN<br>SDINP<br>TEST<br>TOPM<br>TRAN3<br>TRTOSZ         | 0<br>I<br>I           | TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1 |
| VARQ              | (VARQ)         | M    | Desired constraint values [sd]                                                        |       | /GENF /       | ( 61       | CON3<br>SDINP<br>TEST                                                       | I<br>M<br>I           | VARQ<br>VARQ<br>VARQ                                         |
| MDC               |                | M    | Array of drop weight per arc[sd] {                                                    | LBS)  | /GENF /       | ( 89)      | BNTG<br>REU3<br>SDINP                                                       | I<br>I<br>M           | MDC<br>MDC<br>MDC                                            |
| MOHK              |                | М    | Working array, contains TOPEN1, TOPEN2, and PH1                                       | МT    | /STS /        | ( 3)       | ADEQ3A<br>FNTS<br>MODELB<br>MTX3A<br>SDINP<br>TEST                          | 1                     | MORK<br>MORK<br>MORK<br>MORK<br>MORK                         |
| ₩ΤΡ               | [7]            | 0    | Adjustable parameter diagonal meighting matrix order according to IPOINT              |       | /PARAM /      | ( 132)     | MTX3A<br>PAY02<br>SDINP<br>TOPM                                             | I<br>I<br>O<br>D      | WTP<br>WTP<br>WTP<br>WTP                                     |
| מפדש              |                | Ħ    | Input or preset adjustable parameter weighting factors according to type of parameter |       | /PARAM /      | ( 123)     | SDINP<br>TOPM                                                               | M                     | WTPD<br>WTPD                                                 |
| MIPI              |                | I    | Control history curve number                                                          |       | /STS /        | ( 12)      | GUI3A<br>SDINP<br>SDINP                                                     | M<br>M<br>I           | MNGP<br>MNGP<br>WTP I                                        |
| XLAMRF            | ρ <sub>r</sub> | M    | Reference latitude (                                                                  | DEG)  | /GLOBAL/      | ( 4)       | CRASH<br>GEINP<br>REU3<br>SDINP                                             | M<br>I<br>I           | RHDO<br>XLAMRF<br>XLAMRF<br>XLAMRF                           |
| YMURF             | μr             | W    | Reference longitude (                                                                 | BE\$) | /GLOBAL/      | ( 5)       | CRASH<br>GEINP<br>REU3<br>SDINP                                             | M<br>I<br>I<br>M      | UMUO<br>YMURF<br>YMURF<br>YMURF                              |

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  , XMCGV
, CT
, SIDAE
GENF /
, XJR
, IRATED
                     *XMCG
*CULFT
*COD
COMMON /
  XMCGR
CALPHA
XCG
  XMCGA
COE
ZCG
   , GH
                      *XJV
*FRATED
  , GAMMAD
  XXS
   , XKP
                     2 , XK3

2D , XK3D

2V , XK3V

2P , XK3P

2D , XK3O

2M , XK3O

MACH, MACHR,
  , XK1
, XK10
, XK1V
, XK1P
, XK10
, XK1M
, PR
  , XK2
, XK2D
, XK2V
, XK2P
, XK2P
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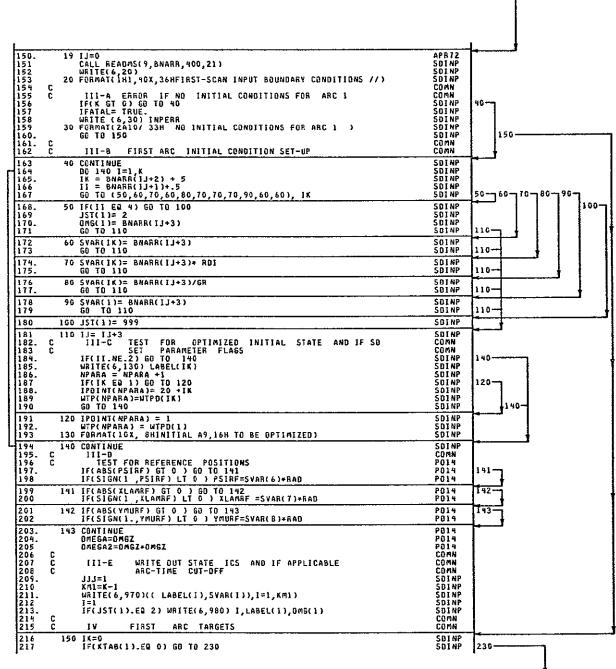
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PHMAX
MAEF
MWDA
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  DIPI
GMAX
MAEA
MAEG
MUDB
   TMULT
JPRO
,ALFMAX
,MAEE
,MZCS
,XE
,OMULT
   TMULT
                              96.
97.
98.
100.
101.
102.
   ARCDAT
ARCDAT
SDINP
PARAM
                              106.
   COMMON/PARAM/
*IPDINT(12),NPARA,NPA ,SPARA(9,12),WTPD (9),WTP
*SPARB(9,12), PARA(12),DPAR(12), 52INV(9,9)

#,DELP(9)
EQUIVALENCE(TINIT, JJDP(1))
EQUIVALENCE(BNARR(301),TARB(1))
EQUIVALENCE(TAL, MNGA),(WTPI, MNGP),(OLPI, MNGP(20))
GIMENSION TAL(46),WTPI(9),OLPI(9)
   PARAM
PARAM
PARAM
SDINP
                             108.
109.
110.
                             111.
112
113.
114.
115.
   SDINP
RETAP
RETAP
   COMN
COMN
SDINP
SDINP
  FLAGS AND COUNTERS SET
  10 CONTINUE
NICHB=0
NSAB=0
                              118
  SDINP
SDINP
                             119.
120.
121.
122.
123.
124.
  NSB=0
INTB=0
  SDINP
   NCHST=D
K= ITAB(1)
ITI=O
NPARA =O
NST=NARC
  SDIAP
SDIAP
SDIAP
  SDINP
  SDINP
SDINP
                              126.
127.
128.
129.
130.
  10P=0
   C
  COMM
   I-A IF QL ONLY (LUM=3) SKIP SD [NPUT (PC=5) IF(LUM.EQ.3) GO TO 19
  COMM
   COMM
RETAP
COMM
RETAP
RETAP
   19
   ΙI
   STEEPEST DESCENT CONVERGANCE AND CONTROL DATA
   II STEEPEST DESCENT CONVERGANCE AND CON MH=5 CALL TABIN(DUMMY,1,ST,111,AR,20G,1D,MN,0,1EDD) LSTWS=LSTWD IF(1EDD,EQ.D) 60 TO 11 WRITE(6,700) MN IFATAL = .TRUE. 60 TO 19 II-A **
                             131.
132.
133.
134.
135.
136.
137.
138.
   NOS
RETAP
RETAP
RETAP
RETAP
   11-
  19
  CHECK FOR INPUT CONSTRAINT TOLERANCES IN ROUTINE TOLPSI
   E
  COMM
                              140
  RETAP
   11 DUMMY = SETTOL(TAL)
                              141.
  RETAP
                             142.
143.
144.
145.
146.
147.
148.
  II -B CHECK AND SET PARAMETER WEIGHTING

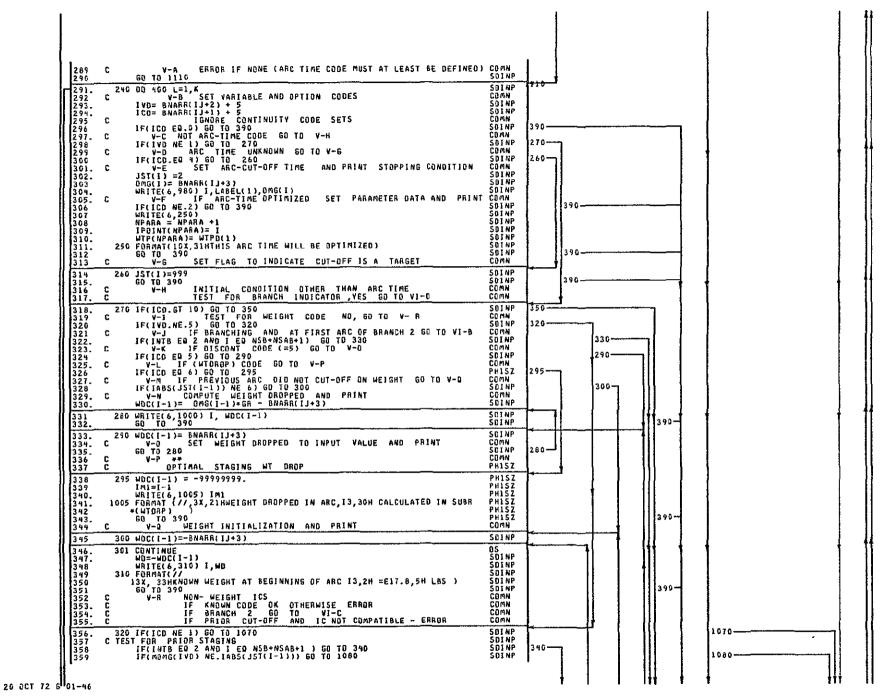
12 DO 14 I=1,9
IF(WTPI(1).GT.O.) WTPD(I)=WTPI(I)
IF(DLPI(I).GT.O.) DELP(I)=DLPI(I)
   COMN
RETAP
RETAP
RETAP
RETAP
COMN
   C
   14
   CONTINUE
  111
  BOUNDARY CONSTITUTE TABLE (CONSTRUCTED IN BHORYC)
  COMM
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```

662



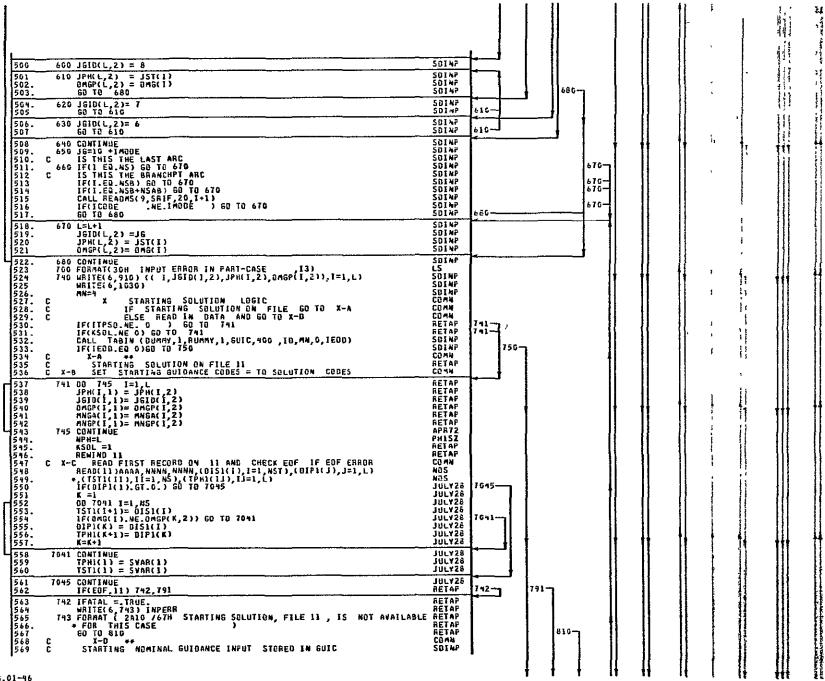
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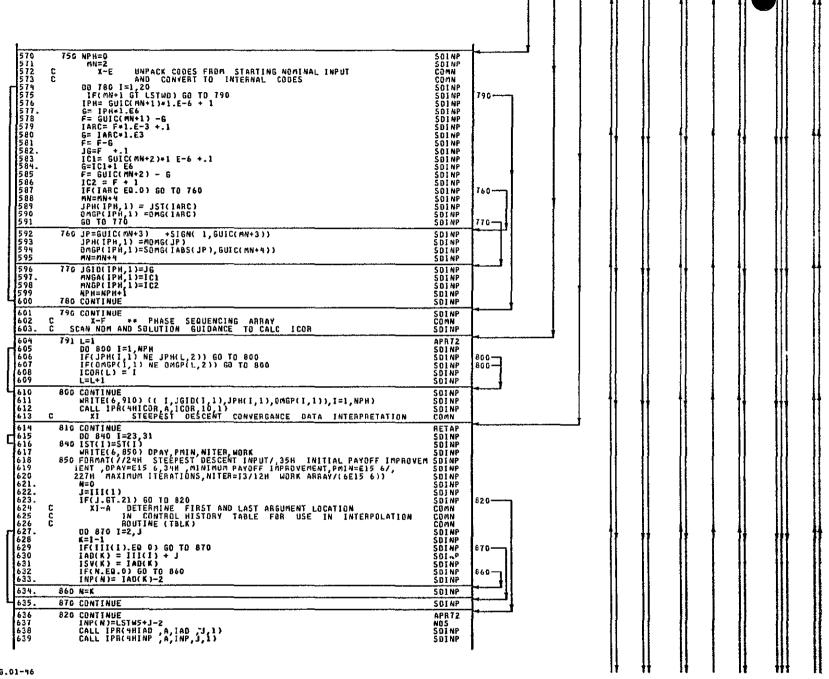
400

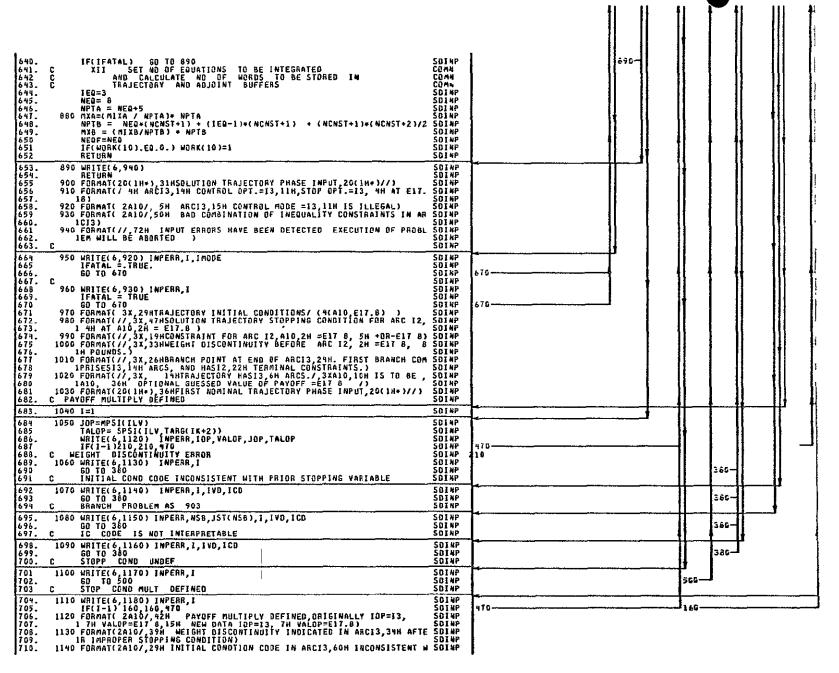


999

(T)







```
43
```

```
11TH PRIOR ARC STOPPING COMDITION VARIABLE NO:13 6M CODE:13) SDIMP
1150 FORMAT(2A16/, 33H BRANCH STOPPING CONDITION IN ARCI3, 6H, JST=13, SOIMP
153H IS INCONSISTENT WITH BRANCH LES INITIAL COMDITION IN/, 7H AR SOIMP
2C=13, 15H. VARIABLE NO:=13, 6H, CODE:13)
1160 FORMAT(2A16/, 42H INITIAL CONDITION CODE FOR ARCI3, 18H, VARIABLE SOIMP
11MUMBER14 2H =116, 22H, IS NOT INTERPRETABLE)
11RO FORMAT(2A10/, 27H STOPPING CONDITION FOR ARCI3, 13H IS UNDEFINED)
1180 FORMAT(2A10/, 28H STOPPING CONDITION FOR ARCI3, 20H IS MULTIPLY DEF SOIMP
11NED)
END
```

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# SUBRØUT I NE SØMG

### FUNCTION SOMG

# Entry SPSI

## Purpose

Convert input external units to internal units. SOMG or SPSI is called from SDINP to convert the units of input boundary condition to internal units; i.e., degrees to radians and pounds to slugs-mass.

| FORTHAN<br>Symbol | MATH<br>Symbol | CODE DESCRIPTION                                                             | STORA<br>BIOCK | GE<br>LOC | SUBMOUTINE USAGE<br>SUBM CODE VAR                                                                                                                                                                                                  |
|-------------------|----------------|------------------------------------------------------------------------------|----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ER                | E <sub>R</sub> | I Earth radius. (FT)                                                         | /GLOBAL/(      | 2)        | COORDS I ER<br>CRASH I REM<br>EQUAS I ER<br>GEINP I ER<br>PADS1 I ER<br>POBC I ER<br>SOMG I ER<br>TRIOSZ I ER                                                                                                                      |
| GR                | 9 r            | I Gravitational acceleration at surface of the earth. (FT/SEC <sup>2</sup> ) | /GLOBAL/(      | 1)        | ACCEL I GR BL5 I GR EQUAS I GR FH3 I GR GEINP I GR GEINP I GR GEINP I GR PADS1 I GR PADS1 I GR PADS1 I GR PADS1 I GR SIZE I GR SIZE I GR SIZE I GR SIZI I GR SIZI I GR SIZI I GR SIZI I GR SIZI I GR SIZI I GR SIZI I GR SIZI I GR |
| RDI               |                | I Angle to radian conversion, .01745329252                                   | /DATA /(       | 3)        | BLICO I ROI<br>DERSA I ROI<br>FNTG I ROI<br>GUISA I RDI<br>MODELA I ROI<br>MODELB I ROI<br>PADESI D ROI<br>PROPE I ROI<br>PROPIN I ROI<br>REYS I ROI<br>SOINP I ROI<br>SONS I RDI                                                  |

SHAG

```
1.
2.
3.
4.
5.
6.
1.
8.
9.
10.
11.
12.
13.
  16-720-730-
   SOM6
SOM6
          20 SOMG= REZ*ROI
RETURN
16.
17.
   SOMG
SOMG
          30 SOMG = REZ/GR
RETURN
40 SOMG = REZ/ER
RETURN
END
  SOME
SOME
SOME
SOME
SOME
18.
19.
20.
21.
22.
```

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# SUBRØUT I NE SPLYNE

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE                | DESCRIPTION                                                                                                                                                                                                | STOHA!            | if<br>LUL | SUMMOU<br>SUMM                                                           | LINE                  | USAGE<br>VAR                                     |
|-------------------|----------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------|--------------------------------------------------------------------------|-----------------------|--------------------------------------------------|
|                   |                |                     |                                                                                                                                                                                                            |                   |           |                                                                          |                       |                                                  |
| IFOB              |                | I Fors              | ward or adjoint integration fing = 1 means forward = 2 means adjoint .                                                                                                                                     | /XCODE5/(         | 178)      | ACCEL<br>BEROCO<br>BLYNE<br>EQUA3<br>IMPUL<br>SPLYNE<br>TOPM             | 1<br>1<br>1<br>1      | 1F08<br>1F08<br>1F08<br>1F08<br>1F08<br>1F08     |
| LOCF              |                | . 50.<br>last       | D word array that corresponds to tables I thru<br>Each entry is an integer that points to the<br>t value of the independent variable of the<br>esponding table.                                            | /TABLE /(         | 1401)     | SPLICO<br>SPLICO<br>SPLIZ<br>SPLIZ<br>SPLYNE<br>SPLYNE<br>THRUP          | M<br>I<br>I<br>I      | LOCF<br>Z<br>LOCF<br>Z<br>LOCF<br>Z<br>Z         |
| <b>LOCI</b>       |                | 50<br>init<br>corr  | D word array that corresponds to tables 1 thruEach entry is an integer that points to the tial value of the independent variable of the responding table A zero entry indicates table input.               | /TABLE /(         | 1)        | SPLICO<br>SPLIZ<br>SPLIZ<br>SPLYNE<br>SPLYNE<br>SPLYNE<br>THRUP<br>THRUP | M<br>I<br>I<br>I      | X<br>FOCI<br>X<br>FOCI<br>X<br>FOCI<br>X         |
| LOCL              |                | 50.<br>Iast         | D word array that corresponds to tables I thru<br>Each entry is an integer that indicates the<br>i interval in which interpolation of the<br>esponding table occured.                                      | /TABLE /(         | 701)      | SPLICO<br>SPLICO<br>SPLIZ<br>SPLIZ<br>SPLYNE<br>SPLYNE<br>THRUP          | M<br>I<br>M           | LOCL<br>A<br>TOCL<br>A<br>A<br>TOCL<br>A         |
| NT                |                | I Larg              | gest univariant table number in this case.                                                                                                                                                                 | /GLOBAL/1         | 66)       | SPLICO<br>SPLIZ<br>SPLYNE                                                | 1                     | NT<br>NT<br>NT                                   |
| x                 |                | 50.<br>init<br>corr | ) word array that corresponds to tables 1 thru<br>Each entry is an integer that points to the<br>Lial value of the independent variable of the<br>esponding table — A zero entry indicates table<br>input. | /TABLÉ /(         | 1)        | SPLICO<br>SPLICO<br>SPLIZ<br>SPLIZ<br>SPLYNE<br>SPLYNE<br>THRUP<br>THRUP | A<br>I<br>I<br>I<br>I | LOCI<br>X<br>LOCI<br>X<br>LOCI<br>X<br>LOCI<br>X |
| Y                 |                | 50<br>last          | ) word array that corresponds to tables 1 thru<br>Each entry, is an integer that indicates the<br>Linterval in which interpolation of the<br>esponding table occured.                                      | <u>/T</u> able /( | 701)      | SPLICO<br>SPLICO<br>SPLIZ<br>SPLIZ<br>SPLYNE<br>SPLYNE<br>THRUP          | M<br>I<br>M<br>I      | LOCL<br>Y<br>LOCL<br>Y<br>LOCL<br>Y<br>Y         |
| Z                 |                | 50<br>last          | ) word array that corresponds to tables I thru<br>Each entry is an integer that points to the<br>Evalue of the independent variable of the<br>esponding table.                                             | /TABLE /(         | 1401)     | SPLICO<br>SPLICO<br>SPLIZ<br>SPLIZ<br>SPLYNE<br>SPLYNE<br>THRUP          | M<br>I<br>I<br>I      | LOCF<br>Z ,<br>LOCF<br>Z<br>LOCF<br>Z<br>Z       |

```
SUBROUTINE SPLYNE(II, I, F, DFDX)
COMMON /TABLE/ TABLE(2100) /GLOBAL/ G(66)
DIMENSION X(1), Y(1), Z(1), LOCI(1), LOCI(1), LOCF(1)
EQUIVALENCE (X, TABLE), (Y, TABLE(701)), (Z, TABLE(1401)),
I(LOCI, X), (LOCL, Y), (LOCF, Z), (NT, G(66))
*ITO (9), ICOR (20), ITI , INTB , JGID(20,2), JPH
*JST (20) , NCNST , NSB , NSAB , NIC
*JST (20) , NCNST , NSB , NSAB , NIC
*120P , ICOP , IFAW , IFAR , IFB , JND
*10PEN , IPH , ISST , IARC , IST
*ITCT , ITER , IVAR , JK , JPS , JS
*KOP , KPST , K , KST , NAD , NCA
*NCN , NEOB , NEQ , NOP , NPH , NE
*NST , IPST , IPRINT , ISTN , IPHN , IST
*IPHNB , IBLK1 , IBLK2 , ISTOP , ISTPP
   SPLYNE
SPLYNE
SPLYNE
SPLYNE
XCODES
XCODES
12345678910112314156171892222345
  (9), ICOR (20), ITI , INTB , JGIO(20,2), JPH (20,2)

*JST (20) , NCNST , NSB , NSAB , NICNB

*120P , ICOP , IFAW , IFAR , IFB , IMD

*10PEN , IPH , ISPH , ISST , IARC , ISTART

*ITCT , ITER , IVAR , JK , JPS , JS

*KOP , KPST , K , KST , NAD , NCASE

*NCN , NEQB , NEQ , NOP , NPH , N

*NST , IPST , IFRINT , ISTN , IFHN , ISTNB

*IPHNB , IBLK1 , IBLK2 , ISTOP , ISTPP , L

*IFOB , NB , LB , MB , NPHP , NPHB

*NCTIN , NEQF , ILAB(8), JPRP, JGI1, MTT, MPIN(20), JP1, JP2, JP3

*OATA SPLINT /6HSPLINE/

*OF FORMAT(1HO, 22HTHE TABLE NO. IN LOC 06 17H IS OUT OF RANGE.)

*IF(IT LE NT) GO TO 30

*IT(IT LE 0) GO TO 40

*IT = LOCI(17)**
  JGIO(20,2), JPH (20,2), NSAB NICNB IND IARC ISTART JPS JS NAD NCASE NPH N ISTNB ISTPP L NPHP NPHB NC20), JP1, JP2
   XCODES
XCODES
XCODES
XCODES
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   SPLYNE
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SPLYNE
SPLYNE
   30 IF(IT LE 0) 60 TO 40
II = LOCI(IT)
IF(II 6T 0) 60 TO 50
ITLOC = XLOCF(IT)
WRITE(6, 20) ITLOC
CALL STPIT (6)
26.
27.
28
29
30.
31
   50-
  SPLYNE
  SPLYNE
SPLYNE
SPLYNE
32.
33
34
  40 F = 0.
DFDX = 0.
   RETURN
  50 IF = LOCF(IT)
IF(IF - II - 1) 60,70,80
  SPLYNE
SPLYNE
 35
36
  ¬ 80·
   60-70-
  60 F = Y(II)
DFDX = 0
RETURN
'37
28
  SPLYNE
  SPLYNE
SPLYNE
 39
   70 Y1 = Y(11)

X1 = X(11)

DFDX=(Y(1F) - Y1)/(X(1F) - X1)

F = Y1 + (T - X1)*DFDX

RETURN
 40
41
42
43
44
  SPLYNE
SPLYNE
SPLYNE
SPLYNE
   SPLYNE
  SPLYNE
SPLYNE
SPLYNE
SPLYNE
SPLYNE
SPLYNE
 45
46.
47.
48.
49.
50.
51.
   90 IF(T LT. X(IF)) GO TO 100

IFM1 = IF - 1

Y1 = Y(IF)

X1 = X(IF)

DEL = X1 - X(IFM1)

DFDX=(Y1 - Y(IFM1))/DEL+ S1XTH+Z(IFM1)+DEL

F = Y1 + (T - X1)+DFDX

RETURN
   SPI YNE
   SPLYNE
  SPLYNE
SPLYNE
  Toc
534.
556.
557
559
60
  SPLYNE
SPLYNE
SPLYNE
SPLYNE
SPLYNE
SPLYNE
 61
62
  100 IL = LOCL(1T)
IF(T - X(IL)) 110,150,120
  SPLYNE
SPLYNE
   110-120-150-
  110 1L = IL - 1
IF(T - X(IL)) 110,140,140
  SPLYNE
SPLYNE
  63
   110-
  140-
  120 IS = IL + 1

DO 120 I = IS, IF

IF(I - X(I ) .LT. 0 ) GO TD 140

130 IL = I
  SPLYNE
SPLYNE
SPLYNE
SPLYNE
 65
66
67.
   14G-
  69
   140 LOCL(IT) = IL
  SPLYNE
```

20 DCT 72 G 01-46

```
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712
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# SUBRØUT I NE STAU

#### Subroutine STAU

## Entry SINIT, ADJUMP

## Purpose

Subroutine STAU has three entry points. The main entry, STAU, computes the arc time sensitivity. Entry SINIT stores initial state sensitivity in the parameter sensitivity matrix, and prints the entire parameter sensitivity matrix at the completion of the adjoint solution.

Entry ADJUMP computes the adjoint discontinuity at the critical staging time for rubber stage optimization.

## Description

The arc time sensitivity equation is given in equation (12.1-2) of Volume I. The rubber stage adjoint discontinuity is given in Section 13 of Volume I.

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE                     | DESCRIPTION                                                           | STORA<br>BLOCK | SE<br>LOC | SUBROUT<br>SUBR C                                                                                                                                         | INE USAG                                                                                                 |
|-------------------|----------------|--------------------------|-----------------------------------------------------------------------|----------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 3111801           | STRIBUL        | ····                     | 0.00117.11018                                                         | BLUER          | LUC       | 3055                                                                                                                                                      | DOE TAN                                                                                                  |
| DWEB              |                | I Sensitiv<br>⊯dight (   | ity of booster stage meight to propeliant<br>ib/lb)                   | /\$1Z1N9/C     | 274)      | STZ2<br>Stau                                                                                                                                              |                                                                                                          |
| <b>GR</b>         | gr             | I Gravitat               | ional acceleration at surface of the earth.<br>(FT/SEC <sup>2</sup> ) | /GLBBAL/(      | 1)        | ACCEL<br>BL5<br>EQUA3<br>FH3<br>GEINP<br>GEINP<br>GEINP<br>DUT<br>PADS1<br>PADS1<br>PADS1<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE<br>SIZE | I GR<br>II GR  |
| IARC              |                | I Arc numbe              | .r                                                                    | /xcodes/(      |           | ADICB3<br>ADID3A<br>ADJUST<br>AST3                                                                                                                        | I IARC I IARC I IARC I IARC I IARC I IARC I IARC I IARC I IARC I IARC I IARC I IARC I IARC I IARC I IARC |
| IPOINT            |                | I Code for<br>descent.   | each adjustable parameter in steepest                                 | /PARAM /C      | 1)        | ADJUST I<br>PRMSET I<br>SDINP (<br>STAU I<br>TOPM I                                                                                                       | IPOINT<br>IPOINT<br>IPOINT<br>IPOINT                                                                     |
| 170               |                | I Constrain              | t option code (internal)                                              | /xcodes/(      |           | ADICB3 I<br>ADICBA I<br>ADIDBA I<br>COMB I<br>SDINP P<br>STAU I<br>TOPM D                                                                                 | 170<br>170<br>170<br>170<br>170                                                                          |
| NEOF              |                | I Number of<br>trajector | equations to be integrated on forward<br>y                            | /XCODES/(      | :         | REU3 I<br>RKTA3A I<br>SDINP O<br>STAU I<br>TOPM O<br>TRAN3 O                                                                                              | NEOF<br>NN<br>NEOF<br>NEOF<br>NEOF                                                                       |
| ipara             |                | I Number of<br>problem.  | adjustable parameters in trajectory                                   | /PARAM /(      | <br>      | ABJUST I BHTG I FHTG I MTX3A I PAY02 I PRMSET I STBU I IEST I TOPM D                                                                                      | NPARA<br>NPARA<br>NPARA<br>NPARA<br>NPARA<br>NPARA                                                       |

8 NOV 72 G 01-46

| FORTRAN<br>Symbol | MATH<br>Symbol                          | CDDE  | DESCRIPTION                                                                                | STORA:<br>Block | Ģ€<br>LOC | SUBROUTING<br>SUBA CODE                                                                                                | USAGE                                     |
|-------------------|-----------------------------------------|-------|--------------------------------------------------------------------------------------------|-----------------|-----------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
|                   |                                         | · · · |                                                                                            |                 |           |                                                                                                                        |                                           |
| SPARA             | S <sup>‡</sup> i                        | Ħ     | Matrix of adjustable parameter sensitivities (including all parameters)                    | /PARAM /(       | 151       | ADJUST I<br>PAYO2 I<br>STAU M<br>TOPM D                                                                                | SPARA<br>SPARA<br>SPARA<br>SPARA          |
| Su                |                                         | Î     | A synthesis data array (37,5) that contains the flyback data and some injection quantities | /51Z1WG/(       |           | SIZE O<br>SIZEMR M<br>SIZIN M<br>SIZIN I<br>SUMDUT M<br>TAMPAR 0<br>TAMPER M<br>THRUST M<br>TRTOSZ M<br>VEHDF M        | **************************************    |
| хL                | $\gamma_{m{\phi}^{\dagger}m{\Omega}}$ 1 | М     | Matrix of adjoint variables                                                                | /STATE3/(       |           | ADICBS M<br>ADICSA M<br>ADICSA M<br>ADIDSA M<br>ASTS M<br>BGETS 0<br>BSTOS :<br>MTXSA I<br>OUT I<br>STAU M<br>STARLS I | XL<br>XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX |
| YOS               | ÿl <sub>7~</sub>                        | Ī     | Array of state derivatives at arc end points                                               | /\$TATE3/(      |           | ADIB3A 1<br>REU3 D                                                                                                     | 405<br>405<br>405<br>405                  |

STAU

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                                 ¢
  STASING TIME SENSITIVITIES
  OVARL(99) , VD(9)
, COSGAM , SINGAM
, COSRHO , OCORHO
   ,544(10)
   SAVBP(15)
   SINGAR
  , MDV
, RDG
, MOR
, MOM
, UDP
   ,00V
,006
,00R
,VDP
,GD0
   PDV
PDS
PDR
PDM
VDO
   12.
13
14.
15
  ÄTTOR
   STATE30
17.
19.
19.
21.
22.
23.
25.
27.
28.
   *IOPEN
  *IOPEN
*ITCT
*KOP
*NCN
*NST
*IPHNB
*IFOB
*NCTIN
  LUMNUM/PARAM/
*IPDINT(12),NPARA,NPA ,SPARA(9,12),WTPD (9),WTP
*SPABB(9,12), PARA(12),DPAR(12),521NV(9,9)

*,DELP(9)
COMMON/GENF/
*MOCCOSON
   CAPETER FERRE FER
  32.
  NF/

BMGP(2G,2), YARG(9),

ACDN(9), BCDN(9)

DT G

RE AACH

PAR ROR

JIMEPH JIMES

JPH (20), D1P1(20)

LIFT POLD

LIFT POLD

QV FVAC

LIFTA DBR

ULFT
  TOL(9) , SVAR(10) COTI(9,9) DCON(9) OPSQ , Q RD CSR , VNR TOP TOS DIP(20) T ME TAX TBURN FPD , MACHR LIFTY DRAGY DRAGR DB ISP
  HOC(20)
DTP
QS
CS
SUMSQ
TR(9)
H
DMP
TBU(20)
  *0MG(20)
*A(9,9)
*DTS
   36.
   *R
*VNU
*SVSQ
*TST(20)
*TLP1(20)
   38.
39.
   41.
42.
43.
  *TIMPR
*AE
*QR
   44.
45
96.
47.
   DRAGA
ISPF
ULFTA
CODAE
SID
  *LIFTR
  DBR
ULFT
XMCGR
CALPHA
XCG
   * LIFTM DBR DBRAGE

* LIFTM DBR DB DBRAGE

* ULFT ULFTV ULFT
   DRAGV
DB
,ULFTV
,XMCGA
,CDE
,ZCS
   , ISP
, ULFTR
, XMCGM
, DELTAE
   48
49.
  55555555557
   , XKS
   .XKP
   , XK2
, XK2B
, XK2V
, XK2P
, XK2P
, XK2M
, PO
   , XK3
, XK3D
, XK3P
, XK3D
, XK3M
, XK3M
  SENF
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SENF
  58.
59
60.
  61
62
63
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FRAT
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  MACH, MÁCHR,
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67.
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72.
73.
74.
                                 C
  PZ(5),
TLNG,
  ۷Q,
  TOLWT,
ISIZE,
PRFLG,
IDVEL,
   WPB,
TRAFLG,
IPASS,
ISPO,
WO,
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SIZING
   //189012345...
1789012345...
  ON OBAL
BALL
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                           TEST FOR PRESENCE OF OPTIMAL STAGE TIME IN POINTER
ARRAY
11S = 1ARC-1
DD 10 1=1, NPARA
JJ = 1
IF(IPDINT(I).EQ.IIS ) GO TO 20
10 CONTINUE
RETURN
11 STAGING TIME SENSITIVITY
20 DD 40 IEMN NA
   26-
                          20 DD 40 I=MN,NN

$5 =0.

00 30 J=1,NEQF

$5 = $5 + $L(J,I) + YDS(11S,J)

30 CONTINUE

$FARA(I,J) = $5

40 CONTINUE

RETURN

OPTIMAL INITIAL COUNTY
  95
96.
97.
98.
100.
101.
102.
103.
105.
106.
107.
                          RETURN

OPTIMAL INITIAL CONDITIONS

ENTRY SINIT

III TEST FOR PRESENCE OF OPTIMAL IC AND COMPUTE SENSITIVIT

DO 60 I=1,NPARA

JJ = I

IF(IPOINT(I).LE.21) 60 TO 60

IIIA COMPUTE SENSITIVITY

JI= IPOINT(JJ) - 21

IF(JI.6T.7) 60 TO 60

DO 50 J=MN,NM

50 SPARA(J,JJ) = XL(JI,J)

AQ CONTINUE
                C
  60
                  C
110.
111.
112.
113.
  60-
  STAU
STAU
STAU
STAU
PH15Z
PH15Z
JULY28
OS
JULY28
                           60 CONTINUE
WRITE(6,76)((SPARA(I,J),I=MN,NN),J=1,NPARA)
TO FORMAT(28HO PARAMETER SENSITIVITIES /(6E20.8))
114.
115.
116.
117.
118.
119.
120.
121.
122.
123.
                                    FORMAT(28HO PARAMETER SENSITIVITIES /(6E20.8))
RETURN
IV ADJUINT DISCONT FOR VARIABLE WT- DROPPED ENTRY ADJUMP
DPLOWB = SQ(4,1)*6R
DO 90 I=MN,NN
IF(ITQ(I).NE.36) SO TO 80
XL(4,I) = XL(4,I)*(1 -DWEB) + DPLOWB
GO TO 90
   JULY28
  05
  90.
                            80 CONTINUE
XL(4,I) = XL(4,I)*(1 -DWEB)
  DS
JULY28
125.
126
 127.
128.
129.
                            90 CONTINUE
RETURN
END
  OS
PH15Z
STAU
```

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# SUBRØUT I NE STPIT

### Subroutine STPIT

### Purpose

Subroutine STPIT is called for fatal errors in steepest descent execution.

## Description

This error routine prints a number message (number comes through argument list) and returns to PADS through a call to entry point SDERR therein.

| FORTHAN | MAIH   | rone    | DESCRIPTION        | STORAL     |     | SUBROUTINE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | USAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------|--------|---------|--------------------|------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PAWROF  | SYMBOL |         | DESCRIT I TOR      | BLOCK      | LOC | SUBR CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | VAR                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 1FATAL  |        | O Fatal | error flag.        | /GLOBAL/(  | 17) | GEINP O<br>PADSI I<br>SDINP M<br>SPLICO M<br>STPIT O                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL<br>IFATAL                                                                                                                                                                                                                                                                                                                                                                                                            |
| . UNO6. |        | O File  | of all output data | /.UNO6./(3 | •   | BLICO OBNORYC OCRASH OCCRASH O | . UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 UNO 6 |

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                    SUBROUTINE STRIT(1)
1234567890.
1123456.
```

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# SUBRØUT I NE STP3

#### Subroutine STP3

## Entry Points. PHSTOP, STSTOP, SETFPO

### Purpose

This routine detects whether arc or phase cut-off will be reached in next integration interval on forward trajectory.

### Description

The logic and equations for this routine are described in Section 15.2 of Volume I. This routine as called from FNTG.

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                                                                                                                                                   | SIORA<br>BLOIK | GE<br>LOC | SUBROUTII<br>Subr Cou                                                                                                        |                                                                                               |
|-------------------|----------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 3171000           | 3111000        |      |                                                                                                                                                                               | DCULK          | LUC       | SUBN CUC                                                                                                                     | )                                                                                             |
| OT                |                | 1    | Integration interval (SEC)                                                                                                                                                    | /GENF /(       | 300)      | BNTG M<br>FNTG M<br>REU3 I<br>RKTA3A I<br>RKTB3A I<br>STP3 I<br>YREF3 O                                                      | 01<br>01<br>01<br>P<br>P<br>01                                                                |
| DVAR              | ÿ              | 1    | State vector derivatives in steepest descent module                                                                                                                           | /STATE3/(      | 15)       | ADICBA M<br>ADICBA M<br>DERBA D<br>DERBA D<br>DENVPRM I<br>PROPIN D<br>REUB I<br>RKTASA I<br>SDERB O<br>STPS I<br>YREFB I    | DVAR<br>DVAR<br>DVAR<br>VT<br>DVAR<br>VD<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>D |
| FP                |                | I    | Current value of cut-off function - non-linear only                                                                                                                           | /GENF /(       | 521)      | DTF3 I<br>STP3 I<br>TOL3 I<br>YREF3 I                                                                                        | FP<br>FP<br>FP                                                                                |
| FPD               |                | I    | Rate of change of non-linear cut-off function                                                                                                                                 | /GENF /(       | 523)      | CON3 I<br>DTF3 I<br>STP3 I<br>YREF3 I                                                                                        | FPD<br>FPD<br>FPD<br>FPD                                                                      |
| FPOLD             |                | 0    | Value of non-linear cut-off function at prior compute interval                                                                                                                | /GENF /(       | 522)      | DTF3 I<br>STP3 O<br>TOL3 O<br>YREF3 I                                                                                        | FPOLD<br>FPOLD<br>FPOLD<br>FPOLD                                                              |
| IARC              |                | ī    | Arc number                                                                                                                                                                    | /xcodes/(      | 146}      | ADICB3 I ADID3A I ADID3A I ADID3T I BNTG M ENVPRM I FNTG M GETIT I MODELA I PROPB I PROPIN I REUS I SDINP M STAU I TRTOS Z I | I ARCCIARCCIARCCIARCCIARCCIARCCIARCCIARC                                                      |
| INEGFL            |                | Ŋ    | A 20 word array that contains the code number of<br>the state variables inequality constraint that<br>applies on each subarc. A zero entry indicates<br>that no SVIC applies. | /GLOBAL/(      | 73)       | PROPB I<br>PROPIN M<br>STP3 M                                                                                                | INEQFL<br>INEQFL<br>INEQFL                                                                    |
| 1SPH              |                | 1    | Sign of phase cut-off                                                                                                                                                         | /XCODES/(      | 144)      | FNTG O<br>STP3 I                                                                                                             | ISPH<br>ISPH                                                                                  |
| 1551              |                | I    | Sign of arc cut-off                                                                                                                                                           | /XCODES/(      | 145)      | FNTG 0<br>STP3 I                                                                                                             | ISST<br>ISST                                                                                  |
| ISTOP             |                | I    | Arc cut-off flag                                                                                                                                                              | /XCODES/(      | 175)      | FNTG M<br>STP3 I                                                                                                             | ISTOP<br>ISTOP                                                                                |
| ISTPP             |                | 1    | Phase cut-off flag                                                                                                                                                            | /xcodes/(      | 176)      | FNTG M<br>STP3 I                                                                                                             | ISTPP<br>ISTPP                                                                                |
| I VAR             |                | 0    | Cut-off variable option indicator                                                                                                                                             | /XCODES/(      | 150)      | FNTG M<br>STP3 0                                                                                                             | IVAR<br>IVAR<br>IVAR                                                                          |

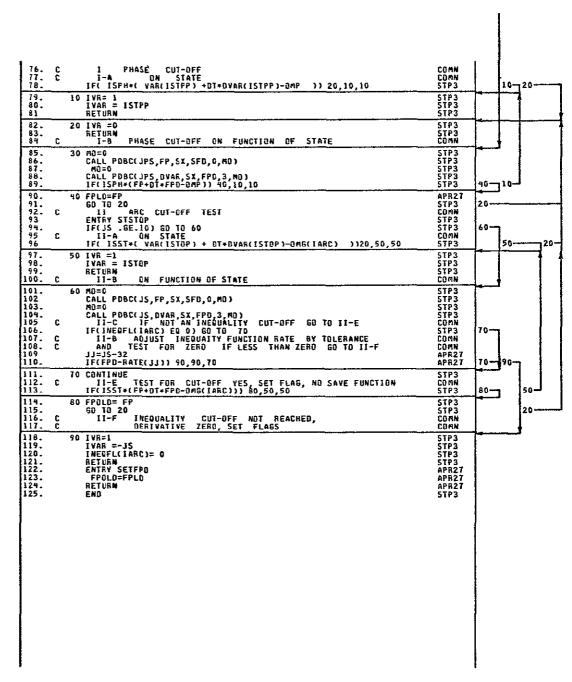
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| FORTHAN | MATH   | CODE DESCRIPTI                          | O NI       | STORA     |      | SUBBOUTIN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | E USAGE                                                            |
|---------|--------|-----------------------------------------|------------|-----------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| SYMROL  | SYMBOL | PESCUILLI                               | UN         | BEUCK     | FOC  | SUBR COD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | E VAR                                                              |
| JPS     |        | 1 Absolute value of phase cut-off o     | ption code | /XCODES/( | 152) | ADID3A 1<br>BNTG M<br>FNTG M<br>STP3 I<br>TOL3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | JPS<br>JPS<br>JPS<br>JPS<br>JPS                                    |
| JS      |        | I Absolute value of arc cut-off opt     | ion code   | /XC00ES/( | 153) | ADICB3 M<br>ADICBA I<br>ADIDBA I<br>BNTG M<br>FNTG M<br>PROPB I<br>PROPIN I<br>STP3 I<br>TOLB I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 12<br>12<br>12<br>12<br>12<br>12<br>12<br>12                       |
| OMG     | Ω      | I Array of arc cut off values Esd]<br>, |            | /GENF /(  | 1)   | ADJUST M FNTG I PRMSET M PROPB 1 SDINP M STP3 I TOPM D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | OMS<br>OMS<br>OMS<br>OMS<br>OMS<br>IOMS                            |
| OMP     |        | I Phase cut-off value                   |            | /GENF /(  | 494) | ADJUST O<br>FNTG M<br>STP3 I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 4M 0<br>4M 0<br>4M 0                                               |
| VAR     | •      | l Relative velocity                     | (FT/SEC)   | /STATE3/( | 1)   | ACCEL I ADICBS O ADJUST O ASTS I BL4 I BL7 I BL8 I CONS I DERSA I ENVPRM I EQUAS I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I MODELA I M | VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR<br>VAR |

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STP3
COAN
COAN
COAN
1
2
3
4
5
6
7
8
9
0
  SUBROUTINE STP3(IVR )
                              00000
  DETECTS WHETHER CUT-OFF WILL BE REACHED IN NEXT INTEGRATION INTERVAL (FORWARD TRAJECTORY)
FLAG IVR=1 =CUT-OFF WILL OCCUR, IVR=0= WILL NOT OCCUR
   COAN
COAN
STATE3D
STATE3D
STATE3D
   COMMON/STATES/
   ATE3/
DVAR (14), VARL (99) DVARL (99) , VO(9)
, VOP(20,9), VDS (20,9), COSGAM , SIMGAM
, COSPSI , SINRHO , COSRHO , OCORHO
, OMEGA , OAEGA2 , GDV , ROV , MDV , PDV
, VDG , GDS , RDG , PDG , VDR , GDR , MDR , PDR , VDR , GDR , MDR , PDR  ,547(10)
,5478P(15)
,000R02
  *VAR(14)
*XL(9,9)
*SINPSI
   STATESOD
STATESOD
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STATESOD
STATESOD
SEMMF
GEMMF
GEMMF
GEMMF
GEMMF
GEMMF
GEMMF
  *SVBV
*VDV
*UDV
   (9).OMESA
 MDV
RDS
MDR
MDM
UDP
HTDR
  ,004
,006
,008
,009
,600
   ≠UDG
  TBL(9) SVAR(10)
COTI(9,9) DCON(9)
OPSO PA RO
CSR VNR
TOP TOS
OIP(20) TIME
TAX TBURN
FPD MACHR
LIFTY DRAGR
DB ISP
   , WDC(20)
, DTP
, QS
, CS
, SUMSQ
, TR(9)
, M
, OMP
, TBU(20)
   GENF
GENF
GENF
  HACHV
  DRAGA
ISPF
ULFTA
CODAE
,SID
  DBR
ULFT
XACGR
CALPHA
XCG
  , DB
, ULFTV
, XACSA
, CDE
, ZCG
   , ISP
, ULFTR
, XMCGM
, DELTAE
, XJ
   GENF
GENF
GENF
GENF
GENF
GENF
  , GH
   , SAMMAD
  , XKG
  , XKP
  XK2
XK2D
XK2Y
XK2P
XK2D
XK2M
PO
   , XK3
, XK3D
, XK3V
, XK3P
, XK3D
, XK3M
, DFDY(3,8)
   GENF
GENF
GENF
GENF
GENF
GENF
GENF
FRAT
GENF
  MACH, MÁCHR,
  GENE
  COMMON /XCDDES/
*ITQ (9),ICOR (20),ITI
*JST (20) ,NCMS
   XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
XCODES
   INTB
,NSB
,IFAR
,ISST
,JK
,KST
,NOP
,ISTN
,ISTOP
  XCODES
  ),ITI
,NCNST
,IFAH
,ISPH
,IVAR
,K
,NEQ
,IPAINT
,IBLK2
  GLOBAL
  GLOBAL
GLOBAL
   RETAP
STP3
APR27
APR27
   STP3
STP3
   130-
```

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# SUBRØUT I NE STVRL3

### Subroutine STVRL3

# Entry. STVRL

## Purpose

STVRL resets adjoint integration variables after discontinuities.

| FORTRAN<br>Symbol | MATH<br>Symbol                 | CODE             | DESCRIPTION                                        | STORA!<br>BLOCK | LOC . | SUBROUT<br>Subr C                                                            | INE USAG                     |
|-------------------|--------------------------------|------------------|----------------------------------------------------|-----------------|-------|------------------------------------------------------------------------------|------------------------------|
| NB                |                                | I Exten<br>probi | nt of integration set during adjoints on branchiem | /XCO DE5/(      | 179)  | ADEQ3A<br>ADICB3<br>ADIC3A<br>BNTG<br>RKTB3A<br>STVRL3                       | M NB<br>M NB<br>O NB<br>I NB |
| VARL              |                                | O Array          | y of variables for adjoint integration             | /STATE3/(       | 29)   | ADICB3<br>ADIC3A<br>PROPIN<br>RKTA3A<br>RKTB3A<br>STVRL3                     | 0 VARL<br>I ZZ<br>M F        |
| XL                | λ <sup>¥</sup> iΩ <sub>J</sub> | I Matri          | ix of adjoint variables                            | /STATE3/(       | 246)  | ADIC3A<br>ADID3A<br>AST3<br>BGET3<br>BST03<br>MTX3A<br>OUT<br>STAU<br>STVRL3 | M XL<br>M XL<br>M XL         |

STVRL3

```
SUBROUTINE STVRL3(LL,MM)

RESETS ADJOINT INTEGRATION VARIABLES AFTER

COMMON/STATE3/
*VAR(14) DVAR (14),VARL (99) DVARL(99) ,VO(9) ,SVY(10) ,STATE3D
*XL(9,9) YOP(20,9),YDS (20,9),COSGAM ,SINGAM ,SAVBP(15) ,STATE3D
*XL(9,9) YOP(20,9),YDS (20,9),COSGAM ,SINGAM ,SAVBP(15) ,STATE3D
*XLV9) GORGA ,OMEGA2 ,STATE3D
*YDV ,GDV ,RDV ,MDV ,PDV ,ODV ,STATE3D
*YDV ,GDV ,RDV ,MDV ,PDV ,ODY ,STATE3D
*YDV ,GDV ,RDV ,MDV ,PDR ,ODR ,STATE3D
*UDG ,VOR ,GDR ,MDR ,PDR ,ODR ,STATE3D
*UDG ,VOR ,GDR ,MDR ,PDR ,ODR ,STATE3D
*GDP ,PDP ,DDP ,UDP ,VDD ,GDD ,STATE3D
*GDP ,PDP ,DDP ,UDP ,VDD ,GDD ,STATE3D
*GDP ,PDP ,DDP ,UDP ,VDD ,GDD ,STATE3D
*SAMEAD ,GDS2GM ,
1.2345.6789011123.145678901123.1456789012222222222233333355
  0000
    36.
37.
38
39.
```

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# SUBRØUT I NE SUMS

#### FUNCTION SUMS

## Purpose

The purpose of SUMS is to compute the weighted sum of squares of constraint misses for use in determining constraint miss convergence.

## Description

SUMS is called from TEST.



| FORTRAN<br>Symbol | MATH<br>5ymbol | CODE      | DESCRIPTION                  | S T OR A G<br>Block | E<br>LOC | SUPROU<br>SUBA                                                            | JTINE USAG<br>CODE VAR                                                          |
|-------------------|----------------|-----------|------------------------------|---------------------|----------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| NCNST             | n              | I Number  | of problem constraints       | /XCO0ES/(           | 132)     | BGET3<br>BSTD3<br>CON3<br>PAYO2<br>SDINP<br>SUMS<br>TEST<br>TOPM<br>TRAN3 | I NCNST I NCNST I NCNST I NCNST I NCNST M NCNST I NCNST I NCNST I NCNST I NCNST |
| TOL               |                | I Toleren | ce on constraint misses [sd] | /GENF /(            | 70)      | SDINP<br>SUMS,<br>TEST                                                    | M TOL<br>I TOL<br>I TOL                                                         |

```
SUMS
COMN
COMN
COMN
FUNCTION SUMS (DC )
   FUNCTION SUMS (DC )

COMPUTES SUM OF SQUARES OF FOR USE IN OETERMINING COMMENSION DC(1)
COMMON/GENF/
OMG(20) , OMGP(20,2), VARQ(9)
*A(9,9) , ACON(9) , BCON(9)
*DTS , DT , GACH
*YNU , PAR , ROR , ROR , ROR , ROR , ROR , TIMEPH , TIMES
*IST(20) , TLS1 (20) , DIP1(20)
*TIMPR , LIFT , DRAG , ROR , PF , FPOLD , ROR , PF , FPOLD , ROR , PF , FPOLD , ROR , PF , FPOLD , ROR , PF , FPOLD , ROR , PF , FPOLD , ROR , FPORD
   CCC
  SUM OF SQUARES OF CONSTRAINT MISSES
N DETERMINING CONTRAINT MISS CONVERGANCE
   SUMS
SENF
SENF
SENF
SENF
SENF
SENF
  TOL(9) , SVAR(10) , COTI(9,9) , DCON(9) , DCON
   WDC(20)
DTP
QS
CS
SUMSQ
TR(9)
W
OMP
TBU(20)
MACHY
   GENF
   GENF
GENF
GENF
GENF
GENF
   DRAGR
ISP
ULFTR
XMCGM
DELTAE
   DRAGA
ISPF
ULFTA
CODAE
SID
  DBR
ULFT
XMCGR
CALPHA
XCG
   URAGV
OB
ULFTV
XMCGA
CDE
ZCG
   SENF
GENF
GENF
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   GENF
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   , XKS
   ,XKP
   GENF
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GENF
   (2 , XK3
(2D , XK3D
(2D , XK3D
(2P , XK3P
(2P , XK3P
(2C , XK3D
(2M , XK3M
(2M , DPDV(3,8)
(2D , AACHR,
   , XK2
, XK20
, XK2V
, XK2P
, XK20
, XK2M
, PO
   FRAT
   GENF
XCODES
   JGID(20,2), JPH (20,2), XCODES
NSAB NECNB XCODES
IFB IND XCODES
IFB IND XCODES
IFB IND XCODES
IFB IND XCODES
IFB IND XCODES
NAD NCASE XCODES
NAD NCASE XCODES
NAPH N XCODES
ISTPH ISTNB XCODES
ISTPH ISTNB XCODES
NPHP NPHP XCODES
SURS
SURS
SURS
SURS
SURS
  ICOP
IPH
ITER
KPST
NEOB
IPST
IBLK1
  *ITCT
*KOP
*NCN
*NST
  *IPHNB
*IFOB
*NCTIN
  SUMS = 0. D0 10 I=1 NCMST

10 SUMS = SUMS + (DC(I)/TDL(I))++2

RETURN
   SUMS
SUMS
```

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# SUBRØUT I NE SYMVRT

#### Subroutine SYMVRT

#### Purpose

This is a utility symmetric matrix inversion routine.

#### Description

SYMVRT is used to invert the "A" matrix as in equation 12.1-25 of Volume 1. SYMVRT is called from several routines including MTX, PAYO2, and TRAN 3. The method is described in E. Rodewig's Matrix Calculus (North Holland Publishing Co., Amsterdam, 1956), pp. 110-114.

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  SUBSCUTINE SYMPRICA, N, ISING)
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  000
  SYMMETRIC MATRIX INVERSION ROUTINE USES CHOLESKY ALGORITHM DIMENSION A( 9, 9),8(9),T( 9)
IX-N
ISING-0
D9 0 10=1,1X
T(10)=1.0
1DM1=10-1
IDM1=10-1
IF(10A1)10,30,10
  SYAVET
  SYAVAT
   15-36-
   10 00 26 J=ID IX

00 20 K=1 10M1

20 A(ID, J)=A(ID, J)-A(K, ID)+A(K, J)+T(K)
                  13.
14.
15.
   SYAVAT
   Ь
   SYAVAT
SYAVAT
                   16.
   36 IF(A(10,10))50,40,60
   SYMYFT
  5G
                   17.
18.
   40 ISING=10
60 TO 210
   SYMVAT
SYMVAT
                  19.
  50 T(ID)=-1.0
   SYMURT
   60 A(10,10)= SORT(ABS(A(10,10))) =T(10)
1F(10P1-1x)70,70,100
                   20.
21.
   TAVAYZ
TAVAYZ
  75-7156-
   TO DO 80 J=IDP1, IX
80 A(ID, J)=A(ID, J)/A(ID, ID)
A(ID, ID)=A(ID, ID)*T(ID)
90 CONTINUE
                  22.
23.
24.
25.
   SYMVAT
SYMVAT
SYMVAT
     Ц
  SYMURT
   SYMMI
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  100 A(IX,IX)=A(IX,IX)+T(IX)

IXM1=IX-1

D0 120 I=1,IXM1

I1=I+1
                  26.
27.
28.
39.
31.
32.
35.
36.
37.
11=I+1
DD 11G J=I1,IX
11D A(I,J)=A(I,J)/A(I,I)
12G A(I,J)=T(I)/A(I,I)
A(IX,IX)=T(IX)/A(IX,IX)
DD 15G I=2,IX
K=I+1
IM1=I-1
DD 15G L=1,IM1
IF(K-IX)13G,13G,15G
  135-150
                  39.
40.
  130 B7 146 J=K, IX
140 A(L, J)=A(L, J)-A(I, J)+A(L, I)
  d
   SYAVET
  SYMERT
  150 A(L,1)=-A(L,1)+A(1,1)

00 180 I=1,IX

B(I)=0.0

00 160 K=I,IX

160 B(I)=B(I)+A(I,K)++2+T(K)

M=I+1

1F(M-IX)170,170,190
                  41.
42.
43.
44.
45.
46.
47.
   SYMYRT
SYMYRT
SYMYRT
SYMYRT
SAMYRT
SAMYRT
   d
  176---196-
   SYMMAT
                 48.
49.
50.
51.
  170 DB 180 J=M,IX
A(J,1)=0.0
DB 180 K=J,IX
180 A(J,I)=A(J,I)+A(I,K)+A(J,K)+T(K)
   SYMVAT
TAVAYZ
TAVAYZ
  SYMURT
                  52.
53
  196 DO 260 I=1,IX
200 A(I,I)=B(I)
   SYMVAT
SYMVAT
  216 RETURN
END
                  54.
55.
   SYMUNT
SYMUNT
```

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# SUBRØUT I NE TBLK

### Subroutine TBLK

## Purpose

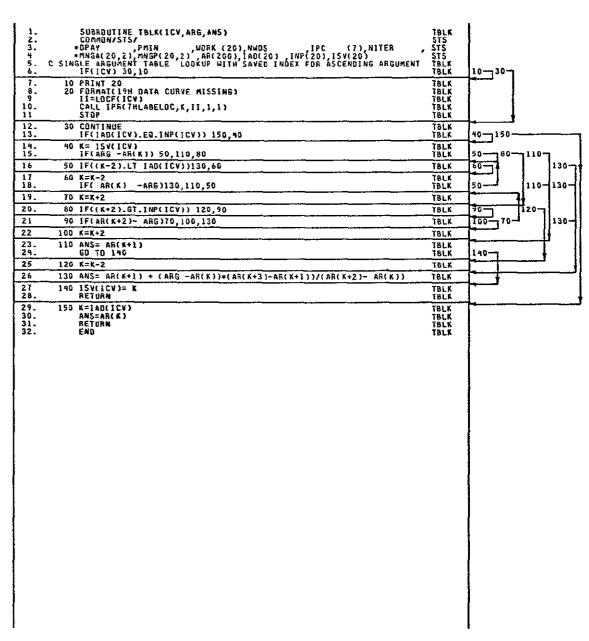
Subroutine TBLK is a single-argument table lookup using linear interpolation.

## Description

This linear interpolation routine is employed for starting-nominal control tables. It saves the index where the last lookup occurred. TBLK is called from GUID3.



| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                          | <u> </u> | TORA( | LOC  | SUBRDI<br>SUBR         |        | USAGE<br>VAR    |
|-------------------|----------------|------|------------------------------------------------------|----------|-------|------|------------------------|--------|-----------------|
| AR                |                | t    | Array for storing starting control history tables    | /STS     | /(    | 112) | SDINP<br>SDINP<br>TBLK | I<br>I | AR<br>III<br>AR |
| IAD               |                | 1    | Starting address of each control history table       | /STS     | /(    | 312) | SDINP<br>TBLK          | M<br>I | I AD<br>I AD    |
| INP               |                | 1    | Index of last argument of each control history table | /STS     | /(    | 332) | SDINP<br>TBLK          | M      | I NP<br>I NP    |
| 154               |                | M    | Saved index of last control history table Jook-up    | /STS     | /(    | 352) | SDINP<br>TBLK          | D<br>M | ISV<br>ISV      |



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# SUBRØUT I NE TEST

#### TEST

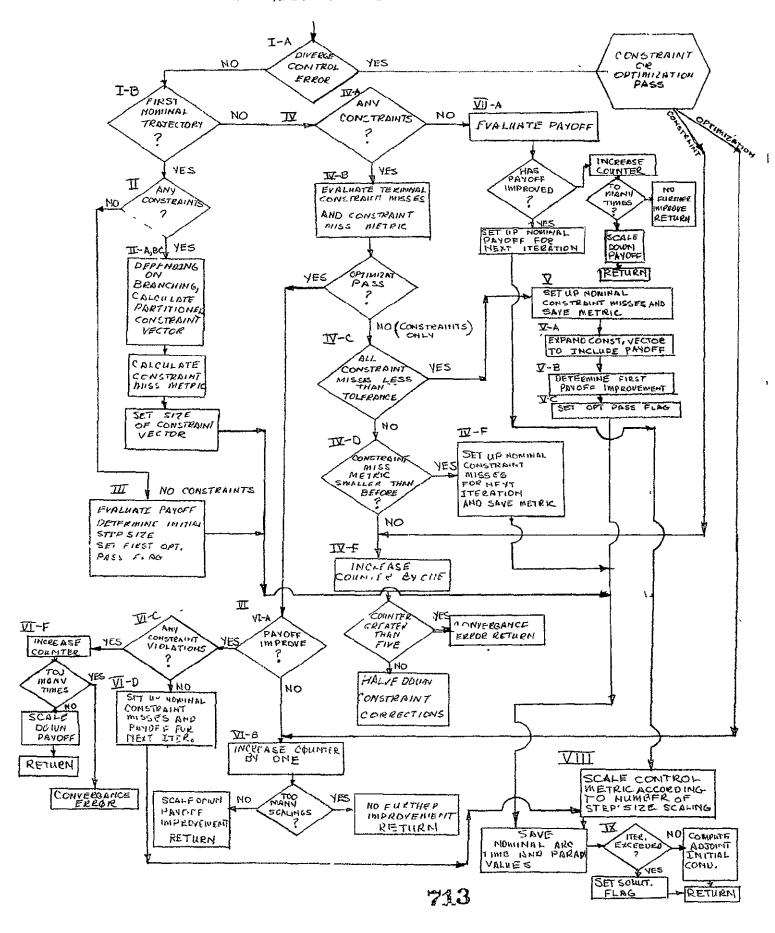
### Purpose

TEST evaluates constraint miss and performance improvement convergance.

### Description

TEST is called by TOPM (steepest descent executive routine) at the completion of each trial trajectory to determine how well solution convergance is going. When difficulties arise, TEST detects them and prints out appropriate messages. Corrective action usually is a successive step size scaling process. When difficulties are not present, TEST calls ADIC to initialize the adjoints for the next adjoint solution-iteration sequence.

#### I TEST FLAGS



| FORTRAN<br>Symbol | MATH<br>Symbol  | CODE | DESCRIPTION                                                                                                             | <u>51</u><br>BLUI | OR A E | E E O C | <u>SUBAQU</u><br>SUBA                                                |                            | F USAGE<br>VAR                                                                         |
|-------------------|-----------------|------|-------------------------------------------------------------------------------------------------------------------------|-------------------|--------|---------|----------------------------------------------------------------------|----------------------------|----------------------------------------------------------------------------------------|
| ACON              |                 | M    | Vector of nominal constraint misses + PAYOFF IMPROVEMENT                                                                | /GENF             | 70     | 190)    | CON3<br>TEST                                                         | 門門                         | ACON<br>ACON                                                                           |
| BCON              |                 | I    | Vector of constraint misses on trial trajectory                                                                         | / GENF            | 70     | 199)    | CON3<br>TEST<br>TOPM                                                 | 0<br>I                     | BCDN<br>BCON<br>BCON                                                                   |
| DCON              | dΨ <sub>i</sub> | M    | Asked for correction in constraint misses and payoff vector                                                             | /GENF             | .\((   | 289)    | CON3<br>MT X3A<br>PAYO2<br>TEST<br>TOPM<br>TRTOSZ                    | 0<br>m<br>m<br>I<br>I      | DCON<br>DCON<br>DCON<br>DCON<br>DCON<br>DCON                                           |
| DIP1              |                 | 0    | Phase initial times for nominal trajectory [sd]                                                                         | /GENF             | /(     | 453)    | GETIT<br>SDINP<br>TEST<br>TOPM                                       | M<br>O<br>I                | DIP1<br>DIP1<br>DIP1<br>DIP1                                                           |
| DISI              |                 | 0    | Arc initial times for nominal trajectory [sd]                                                                           | /GENF             | /(     | 473)    | GETIT<br>SDINP<br>TEST<br>TOPM<br>TRAN3                              | I<br>M<br>O<br>I<br>I      | DIS1<br>DIS1<br>DIS1<br>DIS1<br>DIS1                                                   |
| DPAY              | dΦ              | I    | Initial payoff improvement                                                                                              | /\$TS             | /(     | 1)      | PAYO2<br>SDINP<br>SDINP<br>SDINP<br>TEST<br>TOPM                     | I<br>I<br>O<br>I<br>I<br>D | DPAY<br>DPAY<br>IST<br>ST<br>DPAY<br>IDPAY                                             |
| INTB              |                 | I    | Branching and intermediate constraint flag                                                                              | /XC00E            | ES/(   | 31)     | ADIÇ3A<br>BNTG<br>ENVPRM<br>FNTG<br>SDINP<br>TEST<br>TRAN3<br>TRTOSZ | I<br>I<br>M<br>I<br>I      | INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB<br>INTB                                   |
| IPRINT            |                 | 1    | Print page counter initialization flag                                                                                  | /XC00E            | ES/(   | 168)    | OUT<br>TEST<br>TOPM                                                  | M<br>I<br>O                | IPRINT<br>IPRINT<br>IPRINT                                                             |
| ISTART            |                 | М    | Instialization and divergance flag                                                                                      | \xC096            | ES/(   | 147)    | AST3 BLGCON BLYNE FNTG MOBELA PROPIN REU3 TEST TOPM                  | 0<br>I<br>0                | ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART<br>ISTART |
| ITCT              |                 | M    | Iteration counter                                                                                                       | /XC00E            | ES/(   | 148)    | BNTG<br>OUT<br>TEST<br>TOPM                                          | I<br>I<br>Pl               | ITCT<br>ITCT<br>ITCT<br>ITCT                                                           |
| ITER              |                 | M    | Trajectory pass indicator.  ITER = 1, CONSTRAINTS = 2, OPTIMIZATION = 3, SOLUTION                                       | /xcoo             | E\$/(  | 149)    | AST3 FNTG GETIT MODELA OUT PAYO2 PROPIN TEST TOPM                    | I<br>M<br>I<br>M           | ITER ITER ITER ITER ITER ITER ITER ITER                                                |
| I 20P             |                 | M    | First optimization pass flag sets de = DPAY. Also used to indicate payoff degradation due to restoration of constraints | /XCODE            | E5/(   | 136)    | PAYO2<br>Test<br>Topm                                                | M<br>M<br>O                | 120P<br>120P<br>120P                                                                   |
| KOP               |                 | P    | Counts number of times constraint misses are halved down because of divergance problems                                 | /xcoba            | ES/(   | 154)    | TEST<br>TOPM                                                         | Ħ                          | KOP<br>Kop                                                                             |

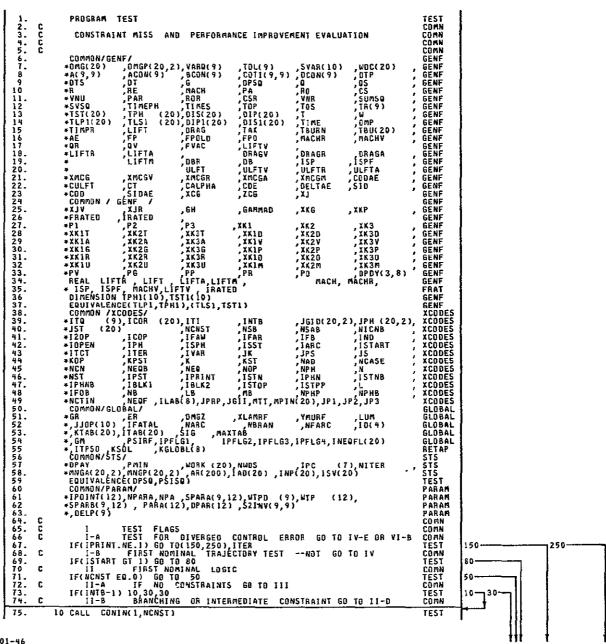
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| FORTRAN | MATH   | CODE                       | DESCRIPTION                                                      | STORAC      |      | SUBBOUTINE                                                                                                                                             |                                                                                        |
|---------|--------|----------------------------|------------------------------------------------------------------|-------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 5YM80L  | SYMBOL |                            | DESCRIFTION                                                      | BLOCK       | LOL  | SUBR CODE                                                                                                                                              | NAR                                                                                    |
| NCN     |        | M Number of                | elements în d¥                                                   | /XCODES/(   | 160) | ADEQ3A I<br>ADIC83 I<br>ADIC3A I<br>ADIO3A I<br>ADJUST I<br>AST3 M<br>BNTG I<br>BST03 I<br>MTX3A I<br>OUT M<br>TEST M<br>TOPM I<br>TRAM3 I<br>TRYOSZ I | NCH<br>NCH<br>NCH<br>NCH<br>NCH<br>NCH<br>NCH<br>NCH<br>NCH<br>NCH                     |
| NCNST   | n      | I Number of                | problem constraints                                              | /XCODES/(   | 132) | BGET3 I<br>BST03 I<br>CON3 I<br>PAYQ2 I<br>SDINP M<br>SUMS I<br>TEST I<br>TOPM I<br>TRAN3 I                                                            | NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST<br>NCNST          |
| NICNB   |        |                            | constraints at intermediate constraint<br>it end of first branch | /XCODES/(   | 135) | ADICB3 I<br>ADIC3A I<br>BNTG I<br>REU3 I<br>SDINP M<br>TEST I<br>TRAN3 I                                                                               | NICNB<br>NICNB<br>NICNB<br>NICNB<br>NICNB<br>NICNB<br>NICNB                            |
| NITER   |        | I Maximum nu               | mber of steepest descent iterations                              | /STS /(     | 31)  | SDINP I<br>TEST I                                                                                                                                      | NITER<br>NITER                                                                         |
| NOP     |        | M Counts num<br>divergance | wber of times payoff is scaled down due to<br>e problems         | o /XCODES/( | 163) | TEST M<br>TOPM I                                                                                                                                       | NOP<br>NOP                                                                             |
| NP AR A |        | i Number of problem        | adjustable parameters in trajectory                              | /PARAM /(   | 13)  | ADJUST I BNTG I FNTG I MTX3A I PAYO2 I PRMSET I SDINP M STAU I TEST I TOPM D                                                                           | NP ARA<br>NP ARA<br>NP ARA<br>NP ARA<br>NP ARA<br>NP ARA<br>NP ARA<br>NP ARA<br>NP ARA |
| NPH     |        | I Number of                | phases in trajectory                                             | /XC0DES/{   | 164) | BNTG I<br>FNTG O<br>PRMSET I<br>SDINP M<br>TEST I<br>TOPM I                                                                                            | NPH<br>NPH<br>NPH<br>NPH<br>NPH<br>NPH                                                 |
| NSAB    |        | I Number of                | arcs on first branch                                             | /XCODES/(   | 134) | ENVPRM I<br>FNTG I                                                                                                                                     | NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB                           |
| NSB     |        |                            | arcs prior to branch point or<br>ite constraint                  | /xcodes/(   | 133) | ADICB3 I<br>BNTG I<br>ENVPRM I<br>FNTG I<br>REU3 I<br>SDINP M<br>TEST I<br>TRAN3 I<br>TRTOSZ I                                                         | NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB<br>NSB                                   |

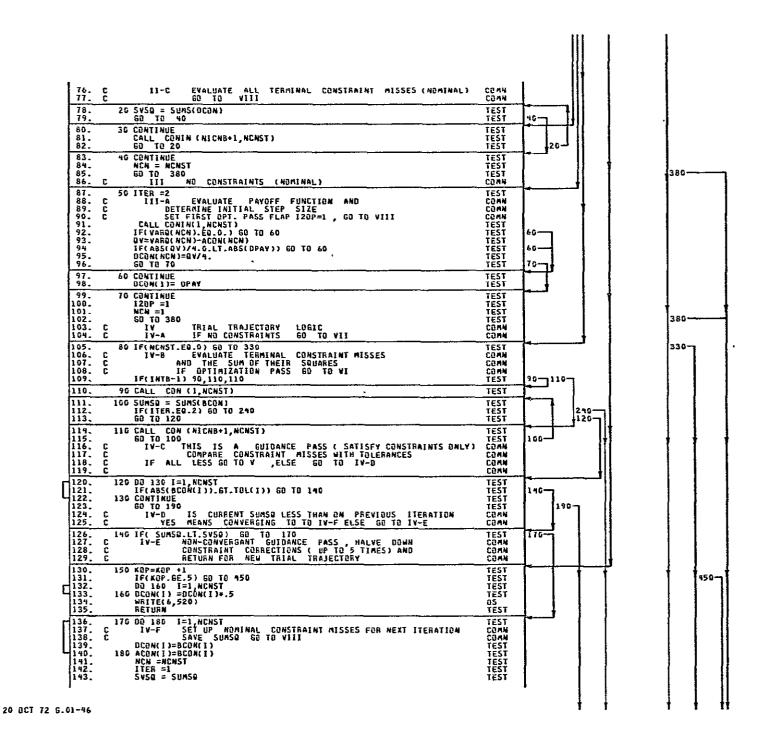
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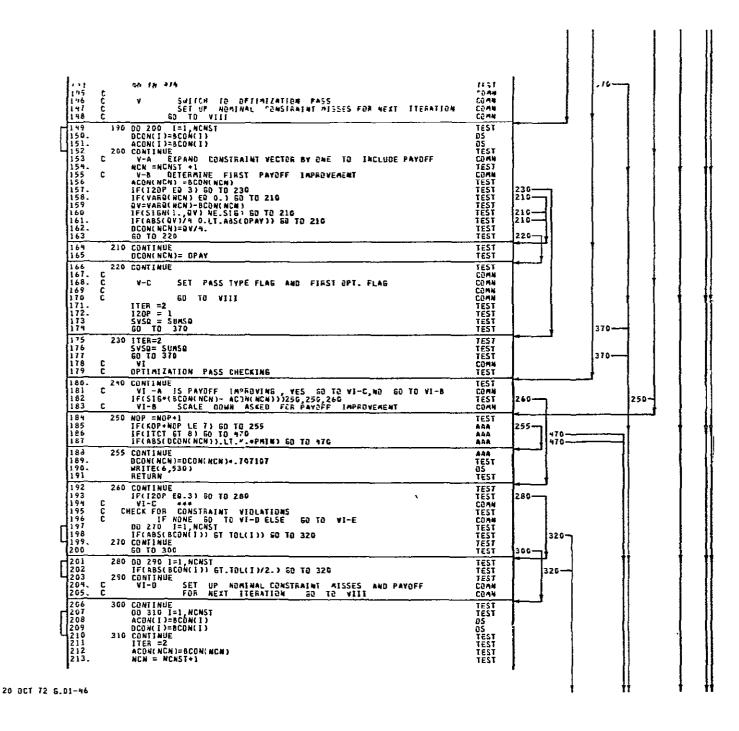
| FORTRAN | HTAM                | CODE | DESCRIPTION                                                                          |             | ORAI |      |                                                                               |                       | USAGE                                                        |
|---------|---------------------|------|--------------------------------------------------------------------------------------|-------------|------|------|-------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------|
| SYMBOL  | SYMBOL              |      | DESCRIPTION                                                                          | всос        | K    | LOC  | SUBH                                                                          | COOL                  | VAR                                                          |
| NST     |                     | I    | Number of arcs in trajectory                                                         | / X C D D E | 5/(  | 166) | BNTG<br>FNTG<br>PROPB<br>SOINP<br>SDINP<br>TEST<br>TOPM<br>TRAN3              | 1<br>0<br>1<br>M<br>1 | NST<br>NST<br>NST<br>NST<br>NST<br>NST<br>NST                |
| PMIN    |                     | I    | Minimum payoff improvement                                                           | /5TS        | /(   | 2)   | PAYO2<br>SDINP<br>TEST                                                        | I<br>I<br>I           | PMIN<br>PMIN<br>PMIN                                         |
| PSISQ   | ( dP ) <sup>2</sup> | M    | Metric of control and parameter changes [sd]                                         | /GENF       | /(   | 302) | PAYO2<br>TEST<br>TRTOS                                                        | M<br>M<br>Z I         | DPSQ<br>PSISQ<br>DPSQ                                        |
| ۵V      |                     | 19   | Partial of dynamic pressure wrt velocity                                             | /GENF       | /(   | 527) | EQUA3<br>TEST<br>VT                                                           | m<br>m<br>I           | 0 A<br>0 A<br>0 A                                            |
| SIG     |                     | 1    | Payoff sign.  5IG < 0- Payoff to be minimized,  SIG > 0: Payoff to be maximized.     | /GLOBA      | L/(  | 65)  | PAYO2<br>SDINP<br>TEST<br>TRAN3                                               | I<br>M<br>I<br>I      | SIG<br>SIG<br>SIG<br>SIG                                     |
| SUMSQ   |                     | M    | Sum of squares of constraint misses (BCON) divided by tolerances on trial trajectory | /GENF       | /(   | 316) | TEST                                                                          | M                     | SUMSQ                                                        |
| SVAR    | y   <sub>t=0</sub>  | Ĭ    | Array of state values at initial problem time (sd)                                   | /GENF       | /(   | 79)  | ADJUST<br>BNT G<br>FNT G<br>PRMSET<br>REU3<br>SDINP<br>TEST<br>TOPM<br>TRTOSS | I<br>M<br>I<br>M<br>I | SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR |
| SVSD    |                     | М    | Same as sumsq but saved for nominal trajectory [sd]                                  | /GENF       | /(   | 317) | TEST                                                                          | M                     | SVSD                                                         |
| TOL     |                     | 1    | Tolerence on constraint misses [sd]                                                  | /GENF       | /(   | 70)  | SDINP<br>SUMS<br>TEST                                                         | M<br>I<br>I           | TOL<br>TOL<br>TOL                                            |
| TPH     |                     | I    | Array of phase end times on trial trajectory [sd]                                    | /GENF       | /(   | 351) | FNTG<br>TEST                                                                  | 0<br>I                | TPH<br>TPH                                                   |
| ТРН1    |                     | ð    | Phase end times for nominal trajectory                                               | /GENF       | /(   | 413) | BNTG<br>GETIT<br>SDINP<br>TEST<br>TOPM                                        | I<br>I<br>0<br>0      | TPH1<br>TPH1<br>TPH1<br>TPH1<br>TPH1                         |
| TST     |                     | I    | Array of arc end times on trial trajectory [sd]                                      | /GENF       | /(   | 331) | ADICB3<br>BNTG<br>FNTG<br>TEST                                                | I<br>O<br>I           | 15T<br>15T<br>15T<br>15T                                     |
| TST1    |                     | Đ    | Arc end times for nominal trajectory                                                 | /GENF       | /(   | 433) | BNTG<br>GETIT<br>PROPIN<br>SDINP<br>TEST<br>TOPM<br>TRANS<br>TRTOSZ           | 0<br>0<br>1<br>1      | 1511<br>1511<br>1511<br>1511<br>1511<br>1511<br>1511         |
| VARQ    | (VARQ)              | I    | Desired constraint values [sd]                                                       | /GENF       | /(   | 61)  | CON3<br>SDINP<br>TEST                                                         | I<br>M<br>I           | VARQ<br>VARQ<br>VARQ                                         |
| MORK    |                     | М    | Working array, contains TOPEN1, TOPEN2, and PHIWT                                    | /STS        | /(   | 3)   | ADEQ3A<br>FNTG<br>MODELE<br>MTX3A<br>SDINP<br>TEST                            | I                     | WORK<br>WORK<br>WORK<br>WORK<br>WORK                         |

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| i   | 217<br>215<br>216                    | į             | CD 10 455<br>VIF CUNSIPALLIS VIOLATED ON OPTIMIZATION PASS<br>STALE DOWN FAYOFF IMPROVENENT RETURN                                                    | TFS F<br>COMM<br>COMM                |          | 360- |      |          |
|-----|--------------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------|------|------|----------|
|     | 21 <i>1</i><br>218.<br>219<br>220.   | 320           | KDP = KDP +1<br>IF(KDP GE 5) GO TO 490<br>IF(KDP ANDP.GE 7) GD TO 490<br>DCDN(NCN)=DCDN(NCN) > 707107                                                 | TEST<br>TEST<br>TEST<br>TEST         | 490      |      |      |          |
|     | 221.<br>222.<br>223<br>224.<br>225.  | c<br>c<br>c   | WRITE(6,540) RETURN VIII ** OPTIMIZATION WITHOUT CONSTRAINTS VII-A EVALUATE PAYOFF AND DETERMINE IF IT HAS IMPROVED IF NOT SCALE DOWN ,DK 60 TO VII-B | OS<br>TEST<br>COMN<br>TEST<br>COMN   |          |      |      |          |
|     | 226.<br>221<br>228.<br>229.          | 330           | IMPROVED IF NOT SCALE DOWN ,DK 60 TO VII-B<br>CONTINUE<br>CALL CON(1,0)<br>IF(SIG=(8CON(1)-ACON(1))) 340,350,350                                      | COMN<br>TEST<br>TEST<br>TEST         | 346350   |      |      |          |
|     | 236.<br>231.<br>232<br>233           | 340           | NOP= NOP+1<br>IF(NOP-GE-5) GO TO 470<br>DCON(1 )=DCON(1 )+ 707107<br>WRITE(6,530)                                                                     | TEST<br>TEST<br>TEST<br>OS<br>TEST   |          |      | 470- |          |
|     | 234.<br>235.<br>236.<br>231.<br>238. | C 350         | RETURN  CONTINUE  VII-B SET UP NOMINAL PAYOFF FOR NEXT ITERATION  ACON(1)=BCON(1)  ITER =2                                                            | TEST<br>COMN<br>TEST<br>TEST         | <b> </b> |      |      |          |
|     | 239.<br>240.<br>241.<br>242.<br>243  | C C C         | NON =1  VIII SET UP DATA FOR NEXT ITERATION SAVE ARC AND PHASE TIMES, SCALE CONTROL METRIC (PSISO) SAVE NOMINAL PARAMETER VALUES                      | TEST<br>COMN<br>COMN<br>COMN<br>COMN | ,        |      |      |          |
|     | 244.<br>245.                         | 360           | CONTINUE<br>PSISQ=PSISQ/(2 0**(KOP+NOP))                                                                                                              | TEST<br>TEST                         |          |      | J    | <u> </u> |
| Ì   | 246<br>247<br>248                    | 380           | WORK(5)=WORK(5)*(.707)07)**(KOP+NOP)  CONTINUE IF(NPARA GT.O) CALL PRMSET(0)                                                                          | TEST<br>TEST<br>TEST<br>OS           | <b>†</b> |      |      |          |
| Г   | 249.<br>250.<br>251.<br>252.<br>253. | 222           | KOP = 0<br>NOP = 0<br>IF(NST EQ 1) SO TO 400<br>DO 390 1=2 NST<br>DIS1(1)=1St(1)                                                                      | OS<br>TEST<br>TEST<br>TEST           | 400-     |      |      |          |
|     | 254.<br>255.<br>256.<br>257.<br>258. |               | TST1(1)=TST(1-1)  TST1(1) =SVAR(1)  DIS1(1)=TST(1)  IF(NPH.EQ 1) G0 TO 420  DD 410 1=2,NPH                                                            | TEST<br>TEST<br>TEST<br>TEST<br>TEST | 420      |      |      |          |
| Ц   | 259.<br>260.<br>261.                 |               | 0[P1(1)=TPH(1)<br>TPH1(1)=TPH(I-1)<br>TPH1(1)=SYAR(1)                                                                                                 | TEST<br>TEST                         | <b></b>  |      |      |          |
|     | 262.<br>263.<br>264<br>265           |               | DIP1(1)=TPH(1) IF(INTB NE.2) GO TO 430 I=NSB+NSAB+1 TST1(1)=TST(NSB)                                                                                  | TEST<br>TEST<br>TEST<br>TEST<br>TEST | 430      |      |      |          |
| l   | 266.<br>267.<br>268.<br>269.         | C<br>C<br>430 | TPH1(NPHP)=TPH(NPHB) IX TEST IF ITERATIONS ARE EXCEEDED IF YES CALL FOR SOLUTION TRAJECTORY ELSE GD TO X CONTINUE                                     | COMN<br>COMN<br>TEST                 |          |      |      |          |
|     | 276.<br>271.<br>272.<br>273.<br>274. | c             | ITCT =ITCT +1 IF(ITCT.GT NITER) GO TO 440 X CALCULATE ADJOINT INITIAL CONDITIONS CALL ADIC RETURN                                                     | TEST<br>TEST<br>COMM<br>TEST<br>TEST | 440      | †    |      |          |
| Ì   | 275.<br>276.<br>277.                 | Ç E           | ITER=3<br>RETURN<br>RROR RETURNS                                                                                                                      | TEST<br>TEST<br>TEST                 |          |      | :    |          |
| 1   | 278.<br>279.<br>286                  |               | WRITE(6.460)<br>FORMAT(33HO UNABLE TO SATISFY CONSTRAINTS )<br>GO TO 510                                                                              | 05<br>05<br>TEST                     | 516-     |      |      |          |
|     | 281<br>282                           | 470<br>480    | WRITE(6,480) ACON(NCN), BCBN(NCN) FORMAT (18H NOMINAL PAYOFF= E20.10,17H TRIAL PAYOFF= E20.10/,                                                       | es<br>TEST                           |          |      |      | -        |
| 6.0 | 1-46                                 |               |                                                                                                                                                       |                                      | ŧ        | ŧ    |      |          |

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```
* 55H NO FURTHER OPTIMIZATION TRIALS WILL BE ATTEMPTED GO TO 510
   ) P014
TEST
   510-
                           GO TO 510

450 MRITE(6,500)

500 FORMAT (48H CONSTRAINTS VIOLATED DURING DETIMIZATION PASS)

XI CONVERGANCE DIFFICULTY RETURN

DISREGARD CURRENT TRIAL AND USE LAST ITERATION

AS SOLUTION TRAJECTORY

510 ISTART =5

1F(NPARA.GT 0) CALL PRESET(1)

RETURN

520 FORMAT (53H TRIAL CONSTRAINT MISSES DID NOT DECREASE 1/2 0

530 FORMAT (45H TRIAL PAYOFF DID NOT IMPROVE 1/2 DOWN)

540 FORMAT (50H TRIAL CONSTRAINT TOLERANCES EXCEEDED 1/2 00WN

END
285.
286.
287.
288.
289.
   OS
TEST
COMN
COMN
COMN
290.
291.
292.
293.
294.
296.
  TRIAL CONSTRAINT MISSES DID NOT DECREASE 1/2 DOWN)
TRIAL PAYOFF DID NOT IMPROVE 1/2 DOWN)
TRIAL CONSTRAINT TOLERANCES EXCEEDED 1/2 DOWN)
```

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FUNCTION TOL PSI

## FUNCTION TØLPSI

### Entry Point SETTOL

## Purpose

 $T\phi$ LPSI supplies a preset constraint tolerance to SDINP during the boundary condition scan.

SETT $\phi$ L is an entry point which permits update of preset constraint tolerances.

```
FUNCTION TOLPSIC 1)
  TOLPSI
  COMMAN APPARATION OF THE PROPERTY APPARATION OF THE PROPERTY APPARATION OF THE PROPERTY APPARATION OF THE PROPERTY APPARATION OF THE PROPERTY 
  PRESET DATA FOR CONSTRAINT MISS TOLERANCES
  PRESET DATA FOR CONSTRAINT MISS TOLERANCES

DIMENSION TAL(36), I(1), IT(1)

EQUIVALENCE (IT, TAL)

SETS CONSTRAINT MISS TOLERANCES

TAU

DATA TAL / 0. , 20. , .01 , 2006.

PSI RHO MU TIME

.07 , 001 , 001 , .2

SQUIG V1 GAMI PSII
20 , 20 , .01 , .07

SEMI LAT ECC INCL ARGP
10000 , .00025 , .01 , .01

SEMI MAJ APDEE PERSEE ANDMLY
10000 , 10000 , .001

CAPY ASSYN ENERGY MOMENTUM

10000 , .01 , 1 E5

SC STOT Q MIDDET

** 6000 , 6000 , .5 , .1

FUEL MT
  MASS
12
HEATLD "
  HEATLD
10.
MUI
-001
ASCNOD
.001
CAP X
10000.
SD
6000.
REY
,200.
  FUEL MT

TOLPSI = TAL(I)
RETURN

OVERIDE PRESET DATA WITH INPUT
ENTRY SETTOL
DD 10 1=1,36
IF(I(J) NE.0) IT(J) = I(J)
10 CONTINUE
SETTOL
RETURN
END
```

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# SUBRØUTINE TØL3

### FUNCTION TOL 3

Entry Points. TOLF, TOLPH

### Purpose

Function TOL 3 sets up data for cut-off refinement during the forward trajectory.

### Description

Entry points TOLF and TOLPH are called from FNTG during arc and phase cut-off refinement calculations.

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE | DESCRIPTION                                                    | <u>Ş</u> T:<br>BLUCK | ORAI | TE<br>LOC | <u>S UBRO</u> (<br>S UBR                                                      |                    | US AGE<br>VAR                    |
|-------------------|----------------|------|----------------------------------------------------------------|----------------------|------|-----------|-------------------------------------------------------------------------------|--------------------|----------------------------------|
| FP                |                | I    | Current value of cut-off function - non-linear only            | /GENF                | 70   | 521)      | DTF3<br>STP3<br>TOL3<br>YREF3                                                 | I<br>I             | FP<br>FP<br>FP                   |
| FPOLD             |                | 9    | Value of non-linear cut-off function at prior compute interval | /GENF                | /(   | 522)      | DTF3<br>STP3<br>TOL3<br>YREF3                                                 | Ð                  | FPOLD<br>FPOLD<br>FPOLD<br>FPOLO |
| IVAR              |                | 1    | Cut-off variable option indicator                              | /XCODE:              | \$/( | 150)      | FNTG<br>STP3<br>TOL3                                                          | M<br>O<br>I        | IVAR<br>IVAR<br>IVAR             |
| JPS               |                | ī    | Absolute value of phase cut-off option code                    | /XC00E               | \$/( | 152)      | ADID3#<br>BNTG<br>FNTG<br>5TP3<br>TOL3                                        | I A<br>M<br>I<br>I | JPS<br>JPS<br>JPS<br>JPS<br>JPS  |
| <b>J</b> \$       |                | I    | Absolute value of arc cut-off option code                      | /xcode:              | \$/( | 153)      | ADICBS<br>ADICSA<br>ADIDSA<br>BNTG<br>FNTG<br>PROPB<br>PROPIA<br>STPS<br>TOLS | 1                  | JS<br>JS<br>JS<br>JS<br>JS<br>JS |

```
FUNCTION TOLS(C)
   TOLS
   CCC
   COMN
COMN
COMN
  SET -UP DATA FOR CUT-OFF REFINEMENT
   NF/
,00GP(20,2),VARD(9)
,ACON(9),SCON(9)
,DT S
,RE ,MACH
,PAR ,ROR
,TIMEPH ,TIMES
,TPH (20),015(20)
,TLS1 (20),01P1(20)
,LIFT ,DRAG
,FP ,FPOLD
,QV ,FVAC
,LIFTA ,DBR
,ULFT
   COMMON/GENF/
  ,TOL(9)
,COTI(9,9)
,DPSQ
,PA
,CSR
,TOP
,DIP(20)
,DIS1(20)
,TAX
,FPD
,FIFTV
DRAGV
,DB
  UDC(20)
DTP
25
CS
SUMSQ
TR(9)
W
OMP
TBU(20)
MACHY
   GENF
  COMMON/GE

#OMG(26)

#A(9,9)

#DTS

#R

#VNU

#SVSQ

#TST(26)

#TLP1(20)

#TIMPR
   ,SVAR(10)
,DCON(9)
  GENF
GENF
   RO VNR TOS
   GENF
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   *TIMPR
*AE
*OR
*LIFTR
  TBURN
MACHR
  DRAGA
ISPF
ULFTA
CODAE
SID
  DRAGR
  DBR
ULFT
XMCGR
CALPHA
XCG
   DHAGV
DB
ULFTV
XMCGA
CDE
ZCG
   GENF
GENF
GENF
GENF
GENF
  , ISP
, ULFTR
, XMCGM
, DELTAE
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229
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  , GAMMAD
   , XKG
  , XKP
   GENE
   , XK2
, XK2D
, XK2V
, XK2P
, XK2D
, XK2M
, PO
  , XK3
, XK3D
, XK3V
, XK3P
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   MACH, MÁCHR,
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  XCODES
XCODES
   , INTB
, NSB
, IFAR
, ISST
, ISST
, NOP
, ISTOP
, ISTOP
   ,JGID(20,2),JPH (20,2),
,NSAB ,NICNB ,IFB ,IND ,IFB ,IND ,ISTART ,JPS ,JS ,NAD ,NCASE ,NPH ,NPH ,ISTAPP ,LTPS ,ISTAPP ,NPHP ,N
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, IPST
, IBLKI
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   NEOF,
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  *NCTIN
COMMON/ST
*VAR(14)
*XL(9,9)
*SINP$1
*SVBV (9
*VBV
*UDV
    49
50
51
52
   (14), VARL (99)

(99), VDS (20,9),

1 , SINRHO

, DMEGRA2

, RDV

, GDR

, GDR

, GDP

, HTDV
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,SAVBP(15)
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MOR
MOM
UDP
HTOR
   ,OCORHO
PDV
PDG
PDR
PDM
VDO
  ODV
ODS
ODR
VOP
GDO
  , BTDV
  61.
62
63.
64
65.
  , COS26#
   STATE3D
   TOL3
TOL3
TOL3
TOL3
  10 m0=0
FPOLD= FP
  67
68.
69.
70
71
72
73.
74.
75.
   TOL3
TOL3
   CALL POBC(JS,FP,S,SD,0,MO)
TOL3 =1.
RETURN
ENTRY TOLPH
IF(IVAR.GT.7) GO TO 20
   TOL3
TOL3
TOL3
TOL3
TOL3
TOL3
TOL3
TOL3
   20-
  RETURN
```

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```
20 FPOLD = FP
MD=0
CALL PDBC(JPS,FP,S,SD,0,A0)
TOL3 =1.
RETURN
END
   TOL3
TOL3
TOL3
TOL3
TOL3
TOL3
76
77.
78.
79.
80.
81.
```

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# SUBRØUT I NE TRAN3

### TRAN 3

### Purpose

TRAN3 computes transformed adjoints to serve as approximations for Euler-Lagrange Multipliers. This approximation is used as a starting solution for the quasi-linearization module.

### Description

The equations for TRAN3 are described in Section 14 of Volume I.

| FORTRAN<br>Symbol | MATH<br>Symbol | COBF | DESCRIPTION                                       | STORAL<br>BLOCK | LOC<br>LOC | SUBROUTINE USAGE<br>SUBR CODE VAR                                                                                                                                   |
|-------------------|----------------|------|---------------------------------------------------|-----------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A                 | А              | 1    | Control integral matrix                           | /GENF /(        | 109)       | ADEQ3A O A ADICB3 M A BGET3 O A BSTG I A BSTG3 I A MTX3A I A PAYO2 I A SDINP I A TRAN3 I A                                                                          |
| COTI              |                | M    | Temp storage for a matrix also called B matrix    | /GENF /(        | 208)       | ADICB3 M COTI<br>MTX3A M B<br>TRAN3 M COTI                                                                                                                          |
| DIS1              |                | I    | Arc initial times for nominal trajectory [sd]     | /GENF /(        | 473)       | GETIT I DISI<br>SOINP M DISI<br>TEST O DISI<br>TOPM I DISI<br>TRANS I DISI                                                                                          |
| FTIME             |                | 1    | Time at which trajectory data set is stored (SEC) | /RETREV/(       | 1)         | AGETB3 O FTIME<br>AST3 O FTIME<br>GETIT I FTIME<br>TRAN3 I FTIME                                                                                                    |
| INTB              |                | I    | Branching and intermediate constraint flag        | /XCODES/(       | 31)        | ADICSA I INTB BNTG I INTB ENVPRM I INTB FNTG I INTB SDINP M INTB TEST I INTB IHANS I INTB TRIDSZ I INTB                                                             |
| ISTN              |                | I    | Stored history data arc number                    | /XCDDES/(       | 169)       | AGETB3 0 ISTN -<br>AST3 0 ISTN<br>GETIT I ISTN<br>TRAN3 I ISTN                                                                                                      |
| NCN               |                | ī    | Number of elements in d#                          | /XCDDES/(       | 160)       | ADEGRA I NCN ADICRA I NCN ADICRA I NCN ADICRA I NCN ADJUST I NCN ASTR M NCN BNTG I NCN BSTOR I NCN MTXRA I NCN DUT I NCN TON TON TOPM I NCN TRANS I NCN TRANS I NCN |
| NCNST             | n              | I    | Number of problem constraints                     | /XCODES/(       | 132)       | BGET3 I NCNST<br>BST03 I NCNST<br>CON3 I NCNST<br>PAY02 I NCNST<br>SDINP M NCNST<br>SUMS I NCNST<br>TEST I NCNST<br>TOPM I NCNST<br>TRAN3 I NCNST                   |

| FORTRAN<br>Symbol | MATH<br>Symbol | CODE   | DESCRIPTION                                                                | STORA!<br>BLDCK | LOC  | SUBROUTINE US<br>Subr code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SAGE<br>Var                                   |
|-------------------|----------------|--------|----------------------------------------------------------------------------|-----------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| NED               |                | ] Num  | ber of integrated states                                                   | /XC00E5/(       | 162) | ADICB3 I MEI ADIC3A I MEI ADIC3A I MEI ADIC3A I MEI AGETB3 I MEI BGET3 I MEI BST03 I MEI BST03 I MEI BST03 I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I MEI COUT I M | 999999999999                                  |
| NEQF              |                |        | per of equations to be integrated on forward<br>jectory                    | /XCODES/(       | 185) | REU3 I NEC<br>RKTA3A I NN<br>SDINP O NEC<br>STAU I NEC<br>TOPM O NEC<br>TRANS O NEC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | QF<br>QF<br>QF                                |
| NI CNB            |                |        | per of constraints at intermediate constraint of or at end of first branch | /XCODES/(       | 135) | ADIC3A I NIG<br>BNTG I NIG<br>REU3 I NIG<br>SDINP M NIG<br>TEST I NIG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CNB<br>CNB<br>CNB<br>CNB<br>CNB<br>CNB<br>CNB |
| NSAB              |                | I Numi | ber of arcs on first branch                                                | /XC0DES/(       | 134) | ADICB3 I NS/<br>BNTG I NS/<br>ENVPRM I NS/<br>FNTG I NS/<br>SDINP M NS/<br>TEST I NS/<br>TRAN3 I NS/<br>TRTOSZ I NS/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | AB<br>AB<br>AB<br>AB<br>AB                    |
| NSB               |                |        | per of arcs prior to branch point or<br>ermediate constraint               | /XCDDES/(       | 133) | ADICB3 I NSI<br>BNTG I NSI<br>ENVPRM I NSI<br>FNTG I NSI<br>REU3 I NSI<br>SDINP M NSI<br>TEST I NSI<br>TRAN3 I NSI<br>TRAN5 I NSI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | B<br>B<br>B<br>B<br>B<br>B                    |
| NST               |                | I Num  | per of arcs in trajectory                                                  | /XC0DES/(       | 166) | BNTG I NST<br>FNTG O NST<br>PROPB I NST<br>SDINP I NST<br>SDINP M NST<br>TEST I NST<br>TOPM I NST<br>TRANS I NST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1<br>1<br>1<br>1                              |
| SIG               |                | I Pay  | off sign SIG < 0. Payoff to be minimized, SIG > 0 Payoff to be maximized.  | /GLOBAL/(       | 65)  | PAYOZ I SIE<br>SDINP M SIE<br>TEST I SIE<br>TRAN3 I SIE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6<br>6                                        |
| TR                |                |        | tor modifier of impulse response function in<br>trol calculation           | /GENF /(        | 322) | MTX3A M TR<br>TRAN3 M TR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                               |
| TST1              |                |        | end times for nominal trajectory                                           | /GENF /(        | 433) | BNTG I TS<br>GETIT I TST<br>PROPIN I TS<br>SDINP O TST<br>TEST O TS<br>TOPM I TST<br>TRAN3 I TST<br>TRIOSZ I TST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | T1<br>T1<br>T1<br>T1<br>T1<br>T1              |

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| FORTHAN | MATH                     | CODE                       | DESCRIPTION                                           | STORA     |      | SUBROUTINE                                                                                  |                                                                                 |
|---------|--------------------------|----------------------------|-------------------------------------------------------|-----------|------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| 5YMBOL  | SYMBOL                   |                            | DESCRIPTION                                           | ちしひしん     | LOC  | SUBA CODE                                                                                   | VAR                                                                             |
| VARL    |                          | M Array of w               | ariables for adjoint integration                      | /STATE3/( | 29)  | ADEQ3A I<br>ADICB3 O<br>ADIC3A O<br>PROPIN I<br>RKTA3A M<br>RKTB3A M<br>STVRL3 O<br>TRAN3 M | VARL<br>VARL<br>VARL<br>ZZ<br>F<br>Y<br>VARL<br>VARL                            |
| XL      | گ <sub>ه</sub> نۍ        | m Matrix of                | adjoint variables                                     | /STATE3/( | 246) | ADICB3 M<br>ADIC3A M<br>ADID3A M<br>AST3 M<br>BGET3 O<br>BST03 I<br>MTX3A I<br>OUT I        | XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>XL<br>X |
| XLAMA   | $V_{\frac{1}{4}I} U^1$   | M Impulse re<br>with angle | sponse function column vector associated<br>of attack | /AEC03 /( | 16)  | ADIC3A B                                                                                    | XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA<br>XLAMA                     |
| XLAMP   | $v_{{\bf J}_1{\bf J}_2}$ | M Impulse re<br>with bank  | sponse function column vector associated<br>angle     | /AEC03 /( | 25)  |                                                                                             | XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP<br>XLAMP                     |

| •        | Ç | PROGRAM T                     |                                                                |                          |                           |                            |                        | TRANS<br>COMN    |
|----------|---|-------------------------------|----------------------------------------------------------------|--------------------------|---------------------------|----------------------------|------------------------|------------------|
|          | C | COMPUT                        | ED TRANSFO<br>Imation for                                      | RMED ADJOIN<br>EULER LAG | TS TO SER'<br>Range mult: | VE AS<br>Ipliers           |                        | COMM             |
|          | _ | COMMON/ST                     | ATF3/                                                          |                          |                           |                            | 5.1                    | STATES           |
| •        |   | *VAR(14)                      | ,DVAR (14                                                      | ), VARL (99)             | BVAHL(99)                 | ,SINGAM                    | ,5VY(10)<br>,SAVBP(15) | STATES           |
|          |   | *XL(9,9)<br>*SINPSI           | COSPSI                                                         | SINRHO                   | , COSRHO                  | ,OCORHO                    | OCORO2                 | STATES           |
|          |   | *5VBV (9                      | COSPSI<br>), OMEGA                                             |                          | ,                         |                            |                        | STATES           |
| -        |   | ****                          |                                                                |                          | MDV                       | ,PDV                       | ,00V ,                 | STATES           |
| •        |   | +UDV<br>+UDG                  | , VOG<br>, VOR<br>, VOM<br>, PDP                               | GDG<br>GDR               | , RDG<br>, MDR            | ,PDG<br>,PDR               | ODG<br>ODR             | CTATES           |
|          |   | *UDR                          | . งกก                                                          |                          |                           |                            | VILP                   | STATES           |
|          |   | ≠ Cnp                         | PDP                                                            |                          | . 999                     | , 700                      | ,GDO ,                 | STATE:           |
|          |   | *P00                          | . 000                                                          | , HT DV                  | ,HTDR                     |                            |                        | STATES           |
| •        |   | *POO<br>REAL MOM<br>COMMON/ST | MDV, MDR<br>ATE3/                                              |                          |                           |                            |                        | STATE:           |
|          |   | *SIN2RO                       | COS2RO                                                         | , COS26M                 |                           |                            |                        | STATE            |
|          |   | COMMON/AF                     | CÓ3/                                                           | -                        |                           |                            |                        | AEC03            |
| -        |   | *APHO                         | . APHR                                                         | , ALPHA                  | , VDA<br>, PHID           | , GDA                      | ,PDA ,                 |                  |
|          |   | ≠SINA<br>≠COSPHI              | , 603#                                                         | PHIO<br>PDPH             | ,XLAMA(9)                 | ,XLAMP(9)                  | ,SINFRI ,              | AECO3            |
|          |   | +CDOM                         | .CLO                                                           | ,FK                      | .XCGM                     | /1:GP                      | ,CLOM                  |                  |
| -        |   | + Cm                          | ,CLO<br>,CMA                                                   |                          | , CmO                     | CMOM                       | ,CLOM<br>,FKM          | AEC03            |
|          |   | +CLAM<br>+CD                  | , CL<br>, CDA                                                  | CLA<br>CDM               | CLM                       | ,                          |                        | AECO3            |
| -        |   | COMMON/GL                     |                                                                | , 6014                   |                           |                            |                        | GLOBAI           |
| •        |   | *GR                           | .ER                                                            | OMGZ                     | XLAMRF                    | , YMURF                    | , LUM                  | GLOBAL           |
|          |   | *,JJDP(10)                    | ,ER<br>,IFATAL<br>,ITAB(20)                                    | NARC                     | , NBRAN                   | NEARC                      | ,10(4)                 | GLOBAL           |
| •        |   | *,KTAB(20)                    | , ITAB(20)<br>, PSIRF, IPF<br>sol , KGL<br>s/<br>, PMIN        | ,SIG ,MAX                | TAB<br>FLG2,IPFLG3,       |                            |                        | GLOBAL           |
| •        |   | +,BM<br>+.ITPS0 K             | SOL KOL                                                        | LUI, IPI<br>OBLÍBI       |                           |                            |                        | GLOBAL<br>RETAP  |
| -        |   | COMMON/ST                     | S/<br>,PMIN<br>),MNGP(20,2                                     | ,                        |                           |                            |                        | ST5              |
| -        |   | *DP AY                        | PMIN                                                           | WORK (20)                | , NWDS                    | ,IPC (1                    | 7),NITER ,             | STS              |
| -        |   | *MNGA(20,2                    | ), MNGP(20,2                                                   | ) ,AR(200),              | IAD(2G) ,INI              | P(20),ISV(                 | 20)                    | STS              |
|          |   | *0MG(20)                      | .NF)<br>- AMGP(20-2                                            | 1 VARO(9)                | 701(9)                    | SVAR(10)                   | , WDC(20)              | GENF<br>GENF     |
|          |   | *A(9.9)                       | ACON(9)                                                        | , VARQ(9)                | .coTi(9.9)                | DCON(9)                    | nie .                  | GENF             |
|          |   | *BTS                          |                                                                |                          |                           |                            |                        | GENF             |
|          |   | *R                            | RE                                                             | ,13409                   | ,ra                       | ,RO                        | ,63 ,                  | GENE             |
|          |   | + V N U<br>+ S √ S Q          | PAR<br>TIMEPH<br>TPH (20                                       | TIMES                    | CSR<br>TOP<br>DIP(20)     | , KU<br>, VNR<br>, TOS     | ,30034 ,               | GENF<br>GENF     |
| -        |   | *TST(20)                      | TPH (20                                                        | ), DIS(20)               | DIP(20)                   | íŤ                         | , in ( , ,             | GENF             |
| •        |   | *TLP1(20)                     | . ILDI LZU                                                     | 1. UEP 1( ZU I           |                           | ,TIME                      |                        | GENF             |
| •        |   | ≯TIMPA<br>*AE                 | LIFT<br>FP                                                     | , DRAG<br>, FPOLD        | TAX                       | TRUKA                      | 3 8 18 2 2 1 1         | GENF<br>GENF     |
| •        |   | *4E<br>*4R                    | , ov_                                                          | FVAC                     | ,FPO<br>,L1FTV            | , MACHR                    | MACHV                  | GENF             |
|          |   | *LIFTR                        | LIFTA                                                          |                          |                           | , DRAGR                    | DRAGA ,                | GENF             |
| •        |   | *                             | LIFTM                                                          | DBR                      |                           |                            | , ISPF                 | GENF             |
| •        |   | *<br>*XMCG                    | , xmcev                                                        | H1 F T                   | THEFTY                    |                            |                        | GENF<br>GENF     |
|          |   | +CULFT                        | , XMCGV<br>, CT                                                | XMCGR<br>CALPHA          | XMCSA<br>CDE              | XMCGM<br>DELTAE            | CODAE ,                | GENF             |
|          |   | +C0D                          | .DIDAE                                                         | XCG                      | , ZCG                     | ,XJ                        | ,310 ,                 | GENF             |
|          |   | COMMON /                      | GÉNÉ /                                                         |                          | -                         |                            |                        | GENF             |
| -        |   | *XJV                          | XJR                                                            | , GH                     | , GAMMAB                  | , XKG                      | ,XKP ,                 | BENE             |
| •        |   | ≠FRATED<br>*P1                | , IRATED<br>, P2                                               | , P3                     | , XK1                     | ,XK2                       | , XK3 ,                | GENF<br>GENF     |
|          |   | *XK1T                         | XK2T                                                           |                          | , îkid                    | , XKZD                     | , XK3D ,               | GENF             |
|          |   | *XK1A                         |                                                                |                          | ,XXIV                     | , XK2V<br>, XK2P<br>, XK2P | ,XK3V ,                |                  |
| -        |   | *XK1G                         |                                                                |                          | , XK 1P                   | , XK2P                     |                        | GENF             |
| -        |   | *XKIR                         | , XKZR<br>, XKZU<br>TR , LIFT                                  | XK3R                     | , XK10<br>, XK1M          |                            | , XK30<br>, XK3M       | GENF<br>GENF     |
| -        |   | *PV                           | , A R Z U                                                      | PP                       | PR                        | XK2M<br>,P0                | , ARSH (3.8)           | GENF             |
|          |   | REAL LIF                      | TR LIFT .                                                      | LIFTA, LIFT              | η΄,                       | MACH                       | ,DPDY(3,8) MACHR,      | GENF             |
|          |   | * ISP, ISP                    | , XX2U<br>, YRG<br>TÅ , LIFT<br>F , MACHV, LI<br>1 TPH1(10), T | FTV , TRATE              | D '                       | •                          | •                      | FRAT             |
|          |   | DIMENSION                     | ! TPH1(10),T<br> CE(TLP1,TPH                                   | 511(10)<br>1) (Ties Te   | T1)                       |                            |                        | SENF<br>SENF     |
|          |   | COMMON /X                     | 'CEL   LF 1 , 1 F 17                                           | 11,(1631,13              | *1 *                      |                            |                        | YCABE            |
|          |   | #1TQ (9                       | ),ICOR (20                                                     | ), JTI                   | , INTB                    | ,J610(20.2                 | 2),JPH (20,2),         | XCODE            |
|          |   | #15T (20                      | . 1                                                            |                          |                           |                            |                        | ACCUE.           |
|          |   | *120P                         |                                                                | IFAD                     |                           |                            | I NH                   | XCODES           |
| <u>.</u> |   | ≠IOPEN<br>≠ITCT               | IPH<br>ITER                                                    | , ISPH<br>, IVAR         |                           | IPS                        | ,1518K1 ,              | XCODES<br>XCODES |
|          |   | *KOP                          | . 8751                                                         | . K                      | . 1.31                    | . NBU                      | . MCHSE .              | XCODES           |
| _        |   | *NCN                          | NEQB                                                           | NEO                      | , NOP                     | , NPH                      | , N ,                  | XCODES           |

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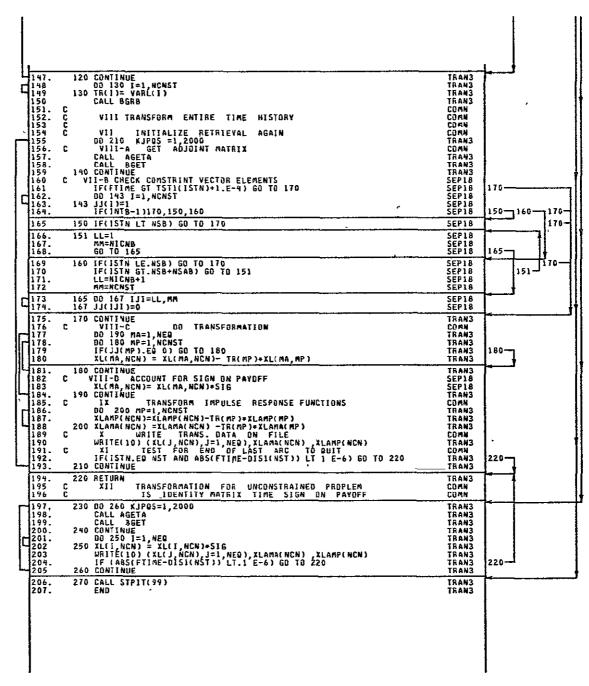
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XCODES
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COMN
TRANS
   I INII
CALL BGRA
CALL BGRB
NEDF=NED+5
SEWIND 10
   INITIALIZE STORAGE RETRIEVAL
  II IF NO CONSTRAINTS GO TO XII
IF(NCNST.EQ O) GO TO 230
III GET FIRST A MATRIX AT INITIAL TIME
CALL BGET
NO=0
   C
  230
  COMN
TRANS
TRANS
   C
   NO=0
IV COMPRESS A MATRIX, STORE IN COTI AND THEN
1V COMPRESS A MATRIX, STORE IN COTI AND THEN
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   10-
   TRANS.
  TRANS
  20-7
   105
  10 JJ(I) =0
  TRANT
  TRANS
TRANS
TRANS
TRANS
TRANS
TRANS
TRANS
TRANS
TRANS
TRANS
  20 CONTINUE

IF(NO.EQ 1) GO TO 230

IA = 0

00 40 1=1, NCN

IF(JJ(I).EQ.0) GO TO 40
  106
107
108
   230
  108
110
111.
112
113
114
  40-
   IA=IA+1
   IA=IA+1
IB= IA-1
DD 30 J=I,NCN
IF( JJ(J):E0 0) GO TO 30
IB =IB +1
COTICIA,IB) = A(I,J)
  30-
  TRAN3
  117.
   30 CONTINUE
   TRANS
   118.
119.
120.
121.
  40 CONTINUE
NM = NO -1
IF(NM GT.1) GO TO 50
COTI(1,1)= 1 / COTI(1,1)
GO TO 60
   TRAN3
  TRANS
TRANS
TRANS
TRANS
  180-
   122
   50 CONTINUE
CALL SYMVRT( COTI, NM , IER)
IF(IER NE 0) GO TO 270
DO 70 1=1,NM
DO 60 J=I,NM
60 COTI(I,J) = COTI(J,I)
70 CONTINUE
   123
124
125
  TRAN3
TRAN3
TRAN3
   276
  126
127
128
129
   TRANS
  TRANS
   TRAN3
   130
131.
132.
134.
135
136
137.
138
139
141
142
144.
144.
   80 CONTINUE
  TRANS
   C
  V COMPUTE TRANSFORMATION MULTIPLIERS
DD 100 J=1, NM
TR(J)= 0
DD 90 1= 1, NM
90 TR(J)= TR(J) + COTI(I,NO)*COTI(I,J)
100 CONTINUE
J=0
  COMM
  COMN
TRANS
TRANS
TRANS
  TRANS
TRANS
TRANS
   COMN
COMN
TRANS
TRANS
   VI ELIMINATE NULL MEMBERS ACCORPING TO HOW A WAS COMPRESSED DO 120 I=1, NCNST IF(JJ(1) E0.0) GO TO 110 J=J+1 VARL(I)=TR(J) GO TO 120
   110-
  TRANS
TRANS
TRANS
  120-
  146.
   116 VARL(I)=0
  TRAN3
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```



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## SUBRØUT I NE TRTØSZ

### Subroutine TRTØSZ

### Entry Points. INTER1, ARCEND, TRJEND

### Purpose

Saves trajectory data required for sizing during solution trajectory integration. Entry INTER1 saves initial states. Entry ARCEND saves data at intermediate arc end points. Entry TRJEND saves final weights, impulsive velocity, and velocity losses.

### Description

Entry INTER1 is called from FNTG at the initiation of the forward trajectory. Entry ARCEND is called by subroutine PROPIN. Entry TRJEND is called by FNTG at the terminus of the solution trajectory.

| FORTRÂN | MATH<br>Symbol      | CODE DESCRIPTION                                                              | STORAGE<br>BLOCK L |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------|---------------------|-------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SYMBOL  | SAMBUL              | DESCRIPTION -                                                                 | BLUCK (            | LOC SUBR CODE VAR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| DCON    | dΨį                 | J Asked for correction in constraint misses and<br>payoff vector              | /GENF /{           | 289) CON3 0 DCDN<br>MTX3A I DCDN<br>PAYQ2 M DCDN<br>TEST M DCDN<br>TQPM I DCON<br>TRTOSZ I DCON                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| DP S Q  | ( dP ) <sup>2</sup> | 1 Metric of control and parameter changes [sd]                                | /GENF /(           | 302) PAYO2 M DPSQ<br>TEST M PSISO<br>TRTOSZ I DPSQ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| QVQ     |                     | O Brb:ter ide⇒i velocity (fps)                                                | /SIZING/(          | 307) SIZOUT I DVO<br>5IZ1 0 DVO<br>5IZ2 0 DVO<br>5IZ3 M DVO<br>5IZ4 0 DVO<br>TRTOSZ 0 DVO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| ER      | E <sub>R</sub>      | l Earth radius. (F)                                                           | ) /GLOBAL/(        | 2) COORDS 1 ER<br>CRASH 1 REM<br>EQUAS 1 ER<br>GEINP 1 ER<br>PADS1 1 ER<br>PDBC 1 ER<br>SUMG 1 ER<br>TRTOSZ 1 ER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| FINM    |                     | I Feet to maut mi conversion, 1 645791629x10 <sup>-4</sup>                    | /DATA /(           | 7) DUT   FTNM<br>PADS1 D FTNM<br>TRTOSZ I FTNM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| IARC    |                     | I Arc number                                                                  | /XCODES/(          | ADICB3   I ARC ADICB3   I ARC ADICB3   I ARC ADICB5   I ARC BNTG M I ARC ENVPRM   I ARC FATG MODELA   I ARC PROPEN   I ARC PROPEN   I ARC ACUS   I ARC STAU   I ARC STAU   I ARC STAU   I ARC ARC STAU   I ARC ARC STAU   I ARC ARC STAU   I ARC ARC STAU   I ARC ARC STAU   I ARC ARC STAU   I ARC ARC ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC I ARC |
| IDVEL   |                     | D Total ideal velocity required to orbit (fps)                                | /51Z1NG/( 1        | 297) SIZ1 I IDVEL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| INTB    |                     | I Branching and intermediate constraint flag                                  | /XCDDES/(          | 31) ACIC3A I INTB<br>BRTG I INTB<br>ENVPRM I INTB<br>FNTG I INTB<br>SCINP M INTB<br>TEST I INTB<br>TRANS I INTB<br>TRANS I INTB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| IPFĽĠ1  |                     | O IPFLS1≠0 supresses print-out of velocity losses an<br>inertial Euler angles | d /GLOBAL/(        | 69) FNTG I IPFLG1<br>OUT I IPFLG1<br>POBC I IPFLG1<br>PRINT I IPFLG1<br>TRTOSZ 0 IPFLG1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 1PFLG2  |                     | 0 IPFLG2≠0 supresses print-out of orbital parameters                          | /GLOBAL/(          | 70) PRINT 1 IPFLG2<br>TRTOSZ 0 IPFLG2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1PFLG3  |                     | O 1PFLG3≠0 supresses print-out of :mpact data                                 | /GLOBAL/(          | 71) OUT I IPFLG3<br>PRINT I IPFLG3<br>TRTOSZ O IPFLG3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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| FORTRAN    | HATH   | CODE DESCRIPTION                                                          | STORA      | GE   | SUBROUTINE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | USAGE                                                                     |
|------------|--------|---------------------------------------------------------------------------|------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| SYMBOL     | SYMBOL | DESCRIPTION                                                               | BLOCK      | LOC  | SUBA CODE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | VAR                                                                       |
| <b>AAL</b> |        | 1 Sizing. Fing                                                            | /SIZING/(  | 313) | GEINP 0 MODELA I PADS1 I PROPIN I SIZIN I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 9749<br>9749<br>9747<br>9747<br>9747<br>9747<br>9747<br>9747              |
| NCN        |        | I Number of elements in d¥                                                | /XCODES/(  | 160) | ADICB3 I ADICSA I ADICSA I ADIDSA I ADIUST I AST3 M I BST03 I MIX3A I DUT I PAY02 M PAY02 M PAY02 M PAY02 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PAY01 M PA | NCON<br>NCON<br>NCON<br>NCON<br>NCON<br>NCON<br>NCON<br>NCON              |
| NSAB       |        | I Number of arcs on first branch                                          | /xcodes/(  | 134) | BNTG I PENVPRM I PENVPRM I PENVPRM I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I PENTG I P | NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB<br>NSAB              |
| NS8        |        | 3 Number of arcs prior to branch point or<br>intermediate constraint<br>, | /xcodes/(  | 133) | BNTG I A<br>ENVPRM I A<br>FNTG I A<br>REUS I A<br>SOINP M A<br>TEST I A<br>TRANS I A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 458<br>458<br>458<br>458<br>458<br>458<br>458<br>458                      |
| R          | R      | I Radial distance from earth center to vehicle (FT                        | ) /SENF—/( | 305) | BL4 I R<br>BL7 I R<br>BL8 I R<br>DER3A I R<br>EQUA3 M R<br>MODELA I R<br>MODELA I R<br>POBC I R<br>POYSA I R<br>TRTOSZ I R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1<br>1<br>1<br>1<br>1                                                     |
| RAD        |        | I Radian to angle conversion, 57 29577951                                 | /DATA /(   | 23   | BEROCO I D<br>BLGCON I R<br>EAVPRM I R<br>EQUAS I R<br>FNIG I R<br>SUISA I R<br>MODELA I R<br>MIXCA I R<br>OUT I R<br>PADSI D R<br>SOINP I R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | DES<br>NAD<br>NAD<br>NAD<br>NAD<br>NAD<br>NAD<br>NAD<br>NAD<br>NAD<br>NAD |

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| FORTRAN | MATH               | COBE                       | DESCRIPTION                                                           |        | STORA     |      | SUBROUTINE                                                                                                                         |                                                                                  |
|---------|--------------------|----------------------------|-----------------------------------------------------------------------|--------|-----------|------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| SYMBOL  | SYMBOL             |                            | DESCRIFTION                                                           |        | BLOCK     | LOC  | SUBA CODE                                                                                                                          | VAR                                                                              |
| SQ      |                    | M A synthesi<br>flyback da | s data array (37,5) that contains<br>ta and some injection quantities | the    | /51ZING/( | 74)  | FLYBRP M ISPRAT I PROBE I PRITVA I RANGE M REU3 O SIZE O SIZE M SIZIN M SIZIN M STAN I SUMMOUT M TAMPAR O THRUST M TROSZ M VEHOF M |                                                                                  |
| STOT    | SŢ                 | I Total rang               | •                                                                     | (FT)   | /ORBII /( | 158) | PDBC Ø                                                                                                                             | STOT<br>STOT<br>STOT                                                             |
| SV      |                    |                            | s array (28) containing staging<br>and misc flags                     |        | /S1ZING/( | 46)  | FLYBKP I<br>ITER8 I<br>RANGE I<br>SIZEMR M<br>SIZIN I<br>SSSP I<br>SUMDUT I<br>TAMPAR O<br>TAMPER M<br>TAMPER M<br>VEHDF M         | 24<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25 |
| SVAR    | y   <sub>t=0</sub> | [ Array of s               | tate values at initial problem tim                                    | e [sd] | /GENF /(  | 79)  | ADJUST 0 : BNTG I : FNTG I : PRMSET M : REU3 I : SDINP M : TEST I : TOPM I :                                                       | SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR<br>SVAR                     |
| SVOCON  |                    | 0 Saved payo               | ff improvement                                                        |        | /SIZING/( | 320) |                                                                                                                                    | SVDCDN                                                                           |
| SVDPSQ  |                    | O Saved conti              | rol matric                                                            |        | /SIZING/( | 319) |                                                                                                                                    | SVDPSØ<br>SVDPSØ                                                                 |
| TST1    |                    | I Arc end to               | mes for nominal trajectory                                            |        | /GENF /(  | 433) | GETIT I PROPIN I I SDINP O TEST O TOPM I TRANS I                                                                                   | TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1<br>TST1                     |
| VSTG    |                    | M Booster st               | aging velocity (fps)                                                  |        | /SIZING/( | 311) |                                                                                                                                    | VSTG<br>VSTG                                                                     |
| u       | W                  | ] Weight                   |                                                                       | (L85)  | /GENF /(  | 412) |                                                                                                                                    |                                                                                  |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE      | DESCRIPTION         | STORAG<br>ølock | E<br>LOC | <u>508800</u><br>5088                                                | TINE USAGE<br>CODE VAR                             |
|-------------------|----------------|-----------|---------------------|-----------------|----------|----------------------------------------------------------------------|----------------------------------------------------|
| WFO               |                | 0 Orbiter | burnout weight (ib) | /S1ZING/(       | 296)     | PAYLOD<br>SIZOUT<br>SIZ1<br>SIZ2<br>SIZ3<br>SIZ4<br>TAMPAR<br>TRIOSZ | I WFO<br>O WFO<br>O WFO<br>O WFO<br>M WFO<br>I WFO |

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| ç | SUBROUTINE TRIOSZ SAVES TRAJECTORY-TO-SIZING DATA DURING SOLUTION TRAJECTOR                                                                                 |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C | ENTRY POINTS INCLUDE<br>INTER1 SAVE INIT. STATES                                                                                                            |
| C | ARCEND SAVES INTERMEDIATE DATA                                                                                                                              |
| C | TRIEND SAVES FINAL DTS. AND IMPULSIVE VELOCITY                                                                                                              |
| L | COMMON/GENF/                                                                                                                                                |
|   | #AMC(26) AMCD(26 2) VADA(4) TO(4) SVAD(10) MDC(26)                                                                                                          |
|   |                                                                                                                                                             |
|   | *DTS DT , G , DPSQ , Q , QS , RR , RE , MACH , PA , RO , CS ,                                                                                               |
|   |                                                                                                                                                             |
|   | #585B 11866B ELDES LID 1115 .18C9) .                                                                                                                        |
|   | *TST(20) TPH (20),015(20) ,01P(20) ,T ,W ,<br>*TLP1(20) ,TLS1 (20),01P1(20) ,01S1(20) ,TIME ,0MP ,                                                          |
|   |                                                                                                                                                             |
|   | ADE SP EPHIN EPH MOTHE MOTHE                                                                                                                                |
|   | ARD THE TELL                                                                                                                                                |
|   | # LIFTM .086 .D8 .15P .15PF .                                                                                                                               |
|   | <ul> <li>ULFT _ULFTY _ULFTA .</li> </ul>                                                                                                                    |
|   | *XMCG _XMCGV _XMCGR _XMCGA .XMCGM .CUDAE .                                                                                                                  |
|   | *CULFT CT CALPHA CDE DELTAE SID ; *COD ,SIDAE ,XCG ,ZCG ,XJ                                                                                                 |
|   | COMMON / GENF /                                                                                                                                             |
|   | *YIV YIR GH CAMMAN YKG YKP                                                                                                                                  |
|   | *FRATED , [RATED , P3 , XK1 , XK2 , XK3 ,                                                                                                                   |
|   | ### ### ### ### #### #### #### ##### ####                                                                                                                   |
|   |                                                                                                                                                             |
|   | TAKIG , AKZG , AKJG , AKIP , AKZP , AKJP                                                                                                                    |
|   |                                                                                                                                                             |
|   | *PY .PS .PP .PR .PD .DPDY(3.8)                                                                                                                              |
|   | REAL LIFTÉ, LIFT, LIFTA LIFTM, MACH, MÁCHR, ** ISP, ISPF, MACHV, LIFTV, ÍRATED                                                                              |
|   | NIMENCIAN TOUISSAS TSTISSAS                                                                                                                                 |
|   |                                                                                                                                                             |
|   | EQUIVALENCE(TLP1) TPH1) (TLS1, TST1)<br>REAL MUB, MUD, 15PB, 15PD, 16VEL, NNB, ND<br>COMMON /S1Z1NG/                                                        |
| C | PURCE II CITIBO PARAMEDERS                                                                                                                                  |
| • | **** UN(2)                                                                                                                                                  |
| c | *5V(Z8), SD(37.5), SE(11), TLAT, TLNG,<br>PHASE I SIZING PARAMERERS                                                                                         |
| L | #URO WICO DMEB DMED TOINT MPR THRAT?.                                                                                                                       |
|   | 3861 NEY RES SEU TSIJE TROFIC INGBSH                                                                                                                        |
|   |                                                                                                                                                             |
|   |                                                                                                                                                             |
|   | anun nun min usta den                                                                                                                                       |
|   | *DVB, DVB, MUB, MUÓ, VSÍG, MPÓ<br>* JTÝP, BECÓ BSTG, ORBI ITNBW, ITNOW,<br>* SVODSO SVOCÓW, INDUÍ, IBPSTG, ISZDC19)                                         |
|   | SVOPSQ , SVOCON , IHUNT , IBPSTG , ISZD(19) COMMON /xCODES/                                                                                                 |
|   | *[TD /9] [CD /20] [T]   INTO   [CTD/20 2) [DU /20 2)                                                                                                        |
|   |                                                                                                                                                             |
|   | *IZUP ILUP ILAW (FAK IFK (NI) .                                                                                                                             |
|   | #11CA DIEK IVAR IK IPS IS                                                                                                                                   |
|   |                                                                                                                                                             |
|   | THEN NEWS NEW NOT BEEL IN .                                                                                                                                 |
|   | TOWN TRIES TO THE TOWN TOWN TOWN TOWN TOWN TRIES TO THE TOWN TRIES TO THE TOWN TOWN TOWN TOWN TOWN TOWN TOWN TO THE TOWN TOWN TOWN TOWN TOWN TOWN TOWN TOWN |
|   | +IFOB ,NB ,LB ,MB ,NPHP ,NPHB ,                                                                                                                             |
|   | *IFOB AB IB MB NPHP NPHB , *NCTIN NEOF , 1LAB(8), JPRP, JG11, MTT, MPIN(20), JP1, JP2, JP3 COMMON / PRINT/ AP(100)                                          |
|   | COMMON / PRINT/ AP(100) COMMON/ ORBIT/ VI, GAMI, PSII, XMUI, P,                                                                                             |
|   | CUMMUNI UNDILL VI. ONMI. FOII. AMUI. F.                                                                                                                     |
|   | + result. Housily. Lars lary anymy forkby                                                                                                                   |
|   | * HANTA, DVIDV, DVIDS                                                                                                                                       |
|   | * neine neine neine neines neinen neinen                                                                                                                    |
|   | * DELDY . DELDG. DELGH . DELDH . DELDES. DELDHD.                                                                                                            |
|   | * DPIONU, DMIDV, DMIDG, ONIOH, DMIOM, DMIOPS,                                                                                                               |

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```
DPDRO
DECDPS,
DIOM,
DBEOH,
   DPDMU
DECORO,
DIOPS
DBEOM
   DPDPS ,
DECOM ,
DIDH ,
DBEDG ,
   DECOG
DIOV
DIOMU
DBEDRÓ,
           76
77
78
79
   DECDY,
DECDMU,
DIORD
DBEDPS,
  DECOH,
DIDG,
DBEDV,
DBEDMU,
   CRBIT
CRBIT
CRBIT
CRBIT
CRBIT
CRBIT
CRBIT
CRBIT
TIGRO
TIGRO
   USMOMU, DAPDV, DAPDG, DAPDH,
DAPDDS, DAPDRO, DAPDHU, DPEDV, DECOG,
DAPDDS, DAPDRO, DAPDHU, DPEDV, DPEDG,
DANDH, DANDM, DANDMS, DANDRO, DANDMU,
DCXDG, OCXDH, OCXDM, DCXDPS, DCXDRO,
BCYDV, DCYUG, DCYOH, DCYOM, DCYDPS, L
DCYDMU, DASDV, DASDG, DASDH, DASDM, L
DASDRO, DASDMU, DENDV, DENDG, DENDH, L
BRODEN, DASDMU, DENDV, DENDK, L
BRODEN, DENDK, DENDK, DENDK, L
BRODEN, DENDK, DENDK, DENDK, L
BRODEN, DENDK, DENDK, DENDK, L
BRODEN, DENDK, DENDK, L

  DBEDG
DNODV
DNODMU,
COMMON/ORBIT/
OSMORO, D
DAPOPS, O
     888888889991234567890
   DNODG
DSMOV,
  ONDOM.
  DNODPS,
  DAPDM ,
  DEXDMO CXDMO   DCYORO,
DASDPS,
DENDM,
DMODH,
  ORBIT
ORBIT
ORBIT
ORBIT
  ORBIT
ORBIT
ORBIT
ORBIT
   , CPSII
  DRBIT
  ORBIT
STATE3D
STATE3D
  ,SVY(10)
,SAVBP(15)
,OCORO2
   STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
STATE3D
     101
102
103
  *5187
*5484
*404
*004
  , MDV
, RDG
, MDR
, MDN
, UDP
   PDV
PDG
PDR
PDM
VDO
   ODV
ODG
ODR
VOP
GDO
  ,GDV
,VDG
,VDR
,VDM
,PDP
   RDV
GDG
GDR
GDM
   104
  +UDG
+UDR
+GDP
106
107
108
109
1110
1111
112.
113
114
115
116
   STATE30
STATE30
STATE30
STATE30
EQUV3
  EQUV3
  EQUV3
EQUV3
DATA
DATA
DATA
GLOBAL
GLOBAL
GLOBAL
GLOBAL
GLOBAL
GLOBAL
TRTOST
TRTOST
 117.
118.
119
120
121
122
123.
124.
   ,LUM
,ID(4)
   ,NFARC
   'MATAB
| IPFLG2, IPFLG3, IPFLG4, INEQFL(20)
 126.
127
128
129
130
131.
   C
  TRTOSZ
  IPFLG2=0
IPFLG3=0
  ÜH
   133
  ÜН
  TPFLG3=0

CONTINUE

SQ(17,2) = SVAR(3)*R

SQ(17,3) = SVAR(4)*S

SQ(17,4) = SVAR(6)*R

SQ(18,1) = SVAR(6)*R

SVDPSQ = DPSQ

SVDCON = QCON.MCN)

IF(1NTB.NE 2) AETURN

SV(21)=1.

CALL ENPPRI
  UH
TRTOSZ
TRTOSZ
TRTOSZ
TRTOSZ
TRTOSZ
TRTOSZ
 134
135
136.
137.
138
139.
140.
142
143
144.
145.
146.
147.
   SVAR(3)*RAD
SVAR(4)
SVAR(6)*RAD
SVAR(7)*RAD
SVAR(8)*RAD
  AAA
AAA
  AAA
AAA
TRTOSZ
TRTOSZ
TRTOSZ
  SV(21)=1.
CALL ENVPRI
RETURN
II INTERMEDIATE ARC DATA
ENTRY ARCEND
IM = IARC-1
IF(JTYP LE 0) GD TO 30
II-4 PHASE I SIZING DATA
  C
  TRTOSZ
AAA
TRTOSZ
```

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| 151.<br>152 C<br>153. C<br>154.<br>155 C | IG CONTINUE  II-8 TEST FOR KEY ARCS  BOOSTER THRUST TERMINATION ARC  IF (IFIX(SO(1,1)).E0.IM1) 80 TO 100  OPTIMAL STAGE TIME              | THIOSZ<br>THIOSZ<br>THIOSZ<br>THIOSZ<br>THIOSZ |              | 156-          | [                                      |     |      |          |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------|---------------|----------------------------------------|-----|------|----------|
| 156.<br>157 C                            | 26 IF( IFIX(SQ(1 ,2)) EQ.IM1) GO TO 110  OPTIMAL PITCHOVER TIME                                                                           | TRTOSZ<br>TRTOSZ                               |              |               | 116-                                   |     | ŀ    |          |
| 158.                                     |                                                                                                                                           | TATOSZ                                         | 120-         | <u>'</u> ,    |                                        |     |      |          |
| 159. C                                   | 3G IF (IFIX(SQ(13,3)) EQ IM1) 60 TO 12G TEST FOR BRANCHING AND INJECTION IF(INTB EQ.2.AND.NSB*NSAB GE.IFIX(SQ(1,3)).AND IARC EQ NSB*NSAB) | AAA                                            |              |               |                                        |     | 566- | ,        |
| 161.<br>162. C                           | * 60 TO 500<br>TEST FOR BRANCHING AND ENTRY TERMINUS                                                                                      | AAA                                            |              |               |                                        |     |      |          |
| 163.                                     | IF(INTB.EQ 2.AND.NSB+NSAB.LT.IF(x(SQ(1,3)).AND.IARC.EQ MSB+NSAB) +SQ TO 600                                                               | AAA                                            |              |               |                                        |     |      | 600-     |
| 165<br>166 C                             | RETURN                                                                                                                                    | TRTOSZ<br>TRTOSZ                               |              |               |                                        |     |      |          |
| 167.                                     | 166 VSTG = AP(17)                                                                                                                         | TRTOSZ                                         |              | لـــــا       | 1                                      |     |      | l        |
| 168.<br>169. C                           | IFCJTYP.EQ.1) GÓ TO 20<br>III-A FHASE II AT STAGING POINT                                                                                 | AAA                                            |              |               |                                        | 26- |      | İ        |
| 170.                                     | QP(9) =AP(9)<br>SW(10)=STOT/ER                                                                                                            | AAA                                            | l            | 1             |                                        |     | ŀ    | 1        |
| 172.                                     | SW(20)=AP(1)                                                                                                                              | AAA                                            | ŀ            | 1             |                                        | 4   | ŀ    | 1        |
| 173.<br>174.                             | SV(7)=W<br>SV(8) =AP(3)                                                                                                                   | FIN]<br>AAA                                    |              | 1             |                                        |     |      |          |
| 175.<br>176.                             | SV(9) =AP(2)<br>SV(10)=AP(4)                                                                                                              | AAA .                                          |              | 1             |                                        |     |      | 1        |
| 177.                                     | \$V(12)=AP(32)<br>\$V(17)=AP(5)                                                                                                           | AAA<br>AAA                                     |              | ł             |                                        |     |      | 1        |
| 179.                                     | 5V(18)=AP(7)                                                                                                                              | AAA                                            |              |               |                                        |     | l    | 1        |
| 181.                                     | SV(19)=AP(6)<br>SV(21)= 0.                                                                                                                | AAA                                            | 1            | İ             |                                        |     |      | 1        |
| 182.                                     | SV(22)= R<br>SV(23)= AP(30)                                                                                                               | AAA<br>AAA                                     |              |               |                                        |     |      | 1        |
| 1184.                                    | 5Y(24)= AP(29)<br>5Y(25)= 0.                                                                                                              | AAA<br>AAA                                     | 1            | 1             |                                        |     | 1    | 1        |
| 186.<br>187.                             | SV(26)= 90 AP(92)                                                                                                                         | AAA                                            | Į            | 1             |                                        |     |      | ĺ        |
| 188.                                     | SQ(12,1) = AP(77)/FTNM/ER<br>SQ(36,1)= AP(55)                                                                                             | AAA                                            | 1            | l             |                                        |     |      | 1        |
| 189.<br>190.                             | \$\text{36}(36,2)= AP(\tilde{56}) \\ \$\tag{37}(1)= AP(1) \\ \$\tag{30} \tag{70} 20                                                       | AAA<br>AAA                                     |              |               | i                                      |     |      | İ        |
| 191.                                     |                                                                                                                                           | TRT05Z                                         | <u> </u>     | <u> </u>      | ئـــــــــــــــــــــــــــــــــــــ | 26- | •    | Į.       |
| 193.                                     | 110 SQ(18,2) = AP(8)<br>60 TB 150                                                                                                         | TRTOSZ<br>Trtosz                               | İ            | 150-          |                                        | ٦   |      | 1        |
| 194.                                     | 120 SQ(18,3) = AP(8) -                                                                                                                    | TRTOSZ                                         |              |               |                                        | ł   |      |          |
| 195.                                     | 150 RETURM<br>300 CONTINUE                                                                                                                | TRTOSZ<br>TRTOSZ                               |              |               |                                        | 1   |      | 1        |
| [197.<br>  198.                          | RETURN<br>ENTRY TRJEND                                                                                                                    | TRTOSZ<br>TRTOSZ                               | 1            |               |                                        | 1   |      | <b>\</b> |
| 199.                                     | IF(JTYP-1)150, 310 400                                                                                                                    | TRTOSZ.                                        | 310-         | <b>3450</b> . | 7156                                   | -   |      | 1        |
| 260<br>201.                              | 310 IDVEL= AP()7)<br>DV0 = AP()7) -VSYG                                                                                                   | TRTOSZ<br>TRTOSZ                               |              | <del></del>   |                                        | 1   |      | 1        |
| 202.                                     | WFD = AP(9)<br>GD TO 150                                                                                                                  | TATOSZ<br>TATOSZ                               |              |               | 156                                    |     |      | 1        |
| 204.                                     | 4GO CONTINUE                                                                                                                              | AAA                                            | <b> -</b>    |               | 1.,,                                   |     |      | 1        |
| 205                                      | IF(INTB.ME.2) GD TO 500<br>IF(IF1X(SD(1,3))-NSB-NSAB)600,500,500                                                                          | AAA                                            | 500-<br>500- |               |                                        |     |      | 600-     |
| 267. C                                   | PHASE II INJECTION PT. DATA                                                                                                               | AAA                                            |              |               |                                        |     |      | <u> </u> |
| 268.<br>269.                             | 500  PZ(1) = AP(7)<br>PZ(2) = AP(6)                                                                                                       | AAA<br>AAA                                     | Γ            |               |                                        |     |      | -        |
| 210.<br>211.                             | PZ(3) = AP(2)                                                                                                                             | AAA                                            | 1            |               |                                        |     |      |          |
| 212.                                     | PI(4) = SVAR(6)*RAD -AP(5)<br>PI(5) = AP(20)                                                                                              | 84 <b>8</b><br>888                             | 1            |               |                                        |     |      |          |
| 214.                                     | SV(7) = SO(3.6)<br>SV(3) = AP(17)                                                                                                         | OS<br>AAA                                      |              |               |                                        |     |      |          |
| 215.<br>216.<br>217.                     | SV(4) = AP(9)<br>SV(5) = SV(7) -SV(4)                                                                                                     | AAA<br>AAA                                     | l            |               |                                        |     |      |          |
| 217.                                     | 50(3,1)= AP(67)<br>50(3,2)= AP(68)                                                                                                        | AAA<br>AAA                                     | Ì            |               |                                        |     |      |          |
| 219.<br>220.<br>221.                     | SQ(3,3)= AP(69)<br>SQ(14,4)= AP(10)<br>SQ(14,5)= AP(2)                                                                                    | AAA                                            | l            |               |                                        |     |      |          |
|                                          | JMLAT. Tip APCIU)                                                                                                                         |                                                |              |               |                                        |     |      |          |

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```
SQ(15,3)= AP(11)
SQ(15,4)= AP(64)
SQ(36,3)= AP(55)
SQ(36,4)= AP(55)
SQ(36,5)= AP(57)
ORBITER BURN TIME
IORBI = SQ(1,3)
SQ(37,2) = AP(1)- TST1(IORBI)
RETURN
FHASE II ENTRY END POINT (RRUISE RANGE)

6GG SW(15) = AP(20)
RETURN
END
222.
223.
224.
225.
226.
227. C
228.
229.
230.
   AAA
AAA
AAA
AAA
AAA
AAA
232
233.
234.
   AAA
AAA
TRTOSZ
```

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# SUBRØUT I NE VT

#### Subroutine VT

### Entry. VTNOP

### Purpose

Subroutine VT computes the control-dependent terms used in calculating the in-plane control vector. Entry VTNØP computes additional terms needed to calculate the partials of the governing equations with respect to the state.

### Description

Subroutine VT is called by BLGCØN within its iterative scheme which solves for the in-plane control vector. This occurs on both forward trajectories and backward adjoint solutions. Entry VTNØP is called by BLGCØN only on backward adjoint solutions after the governing equations have been solved.

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| FORTRAN<br>Symbol | MATH<br>Symbol         | CODE DESCRIPTION |                          |       | STORASE |           |      | SUBBOUTINE USAGI                                                            |                                                |                                                                      |
|-------------------|------------------------|------------------|--------------------------|-------|---------|-----------|------|-----------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------|
|                   |                        | COD              | CODE DESCRIPTION         |       |         | BLOIK LOL |      |                                                                             | SUBR LODE V                                    |                                                                      |
| АШРНА             | α                      | ī                | Angle of attack          | (AAD) | /AECO3  | /(        | 3)   | BEROCO<br>BLGCON<br>BLZ<br>FNTG<br>MAMECO<br>MODELA<br>MODELB<br>REU3<br>VT | M<br>1<br>0<br>1<br>M                          | ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA<br>ALPHA |
| CĐ                | c <sub>D</sub>         | I                | Drag coefficient ,       |       | /AEC03  | /(        | 52)  | BEROCO<br>OUT<br>VT                                                         |                                                | CD<br>CD<br>CD                                                       |
| CDA               | aC <mark>o</mark> /a∝  | I                | See symbol               |       | /AEC03  | /(        | 53)  | BEROCO<br>VT                                                                | M<br>I                                         | CDA<br>CDA                                                           |
| CDM               | aC <sup>D</sup> ∖9W    | I                | See symbol               |       | /AEC03  | /(        | 54)  | BEROCO<br>VT                                                                |                                                | CDM<br>CDM                                                           |
| CL                | cr                     | I                | Lift coefficient         |       | /AEC03  | /(        | 49)  | BEROCO<br>OUT<br>VT                                                         |                                                | CL<br>CL                                                             |
| CLA               | c <sup>∟°</sup>        | Ī                | Lift coefficient slope   |       | /AECO3  | /(        | 50)  | BEROCO<br>EQUA3<br>VT                                                       | M<br>M<br>I                                    | CLA<br>CLA<br>CLA                                                    |
| CLM               | 9C <sup>r</sup> \9w    | 1                | See symbo!               |       | /AEC03  | /(        | 51)  | BEROCO<br>VT                                                                |                                                | CLM<br>CLM                                                           |
| CM                | e <sup>M</sup>         | I                | Moment coefficient       |       | /AEC03  | 70        | 41)  | MAMECO<br>VT                                                                | 0<br>I                                         | CM<br>CM                                                             |
| CMA               | C <sup>Mα</sup>        | I                | Moment coefficient slope |       | /AECU3  | H         | 42)  | EQUA3<br>MAMECO<br>VT                                                       | M<br>I<br>I                                    | CMA<br>CMA<br>CMA                                                    |
| CMM               | ∂C <sup>M</sup> /9W    | I                | See symbol               |       | /AECO3  | /(        | 44)  | MAMECO<br>VT                                                                | 0<br>I                                         | CMM<br>CMM                                                           |
| COD               | cos(s <sub>E</sub> )   | W                | See symbol               |       | /GENF   | /(        | 556) | EL2<br>OUT<br>VT                                                            | I<br>I                                         | COD<br>COD                                                           |
| CODAE             | cos(α-ε <sub>Ε</sub> ) | ð                | See symbol               |       | /GENF   | 10        | 549) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>SDER3<br>VT                     | I<br>I<br>I<br>I<br>I<br>I                     | CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE<br>CODAE          |
| COSA              | ¢ 0 5 ∝                | M                | See symphof              |       | /AEC03  | /(        | 8)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>OUT<br>VT                       | I                                              | COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA<br>COSA         |
| DB                | D <sub>b</sub>         | Ī                | Base drag                | (LBS) | ∕ GENF  | /(        | 537) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>EQUA3<br>FH3<br>QUT<br>SOER3<br>VT     | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | DB<br>DB<br>DB<br>DB<br>DB<br>DB<br>DB<br>DB<br>DB                   |

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| FORTHAN<br>Symbol | MATH<br>5YMBOL | CODE | DESCRIPTION                         |             |          | STURASE<br>BLUK LOT |                                                                                |                                 | USAGE<br>VAR                                                 |
|-------------------|----------------|------|-------------------------------------|-------------|----------|---------------------|--------------------------------------------------------------------------------|---------------------------------|--------------------------------------------------------------|
|                   |                |      |                                     | <del></del> | 700 "    |                     | SUBR                                                                           |                                 | . , , , , , ,                                                |
| OBR               |                | I F  | Partial of base drag wrt altitude   |             | /GENF /  | ( 536)              | ACCEL<br>BL4<br>BL6<br>BL7<br>BLB<br>EQUA3<br>FH3<br>VT                        | ]<br>[<br>[<br>]<br>[<br>]      | DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR<br>DBR         |
| DELTAE            | <sup>8</sup> E | 1 6  | Engine gimbal deflection angle      | (RAD)       | /GENF /  | ( 554)              | BLGCON<br>EL1<br>OUT<br>REU3<br>VT                                             | 1<br>1<br>0<br>1                | DELTAE<br>DELTAE<br>DELTAE<br>DELTAE<br>DELTAE               |
| URAG              | D              | M t  | Aerodynamic drag                    | (LBS)       | /GENF /  | ( 497)              | ACCEL<br>BL5<br>BL7<br>BL8<br>ENVPRM<br>FH3<br>OUT<br>PROPB<br>PROPIN<br>SDER3 | I<br>O                          | DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG<br>DRAG |
| DRAGA             |                | M P  | Partial of drag wrt angle of attack |             | /GENF /  | 534)                | ACCEL<br>BL5<br>BL7<br>BL8<br>FH3<br>VT                                        | 1                               | DRAGA<br>DRAGA<br>DRAGA<br>DRAGA<br>ORAGA<br>DRAGA           |
| DRAGR             |                | M P  | 'artial drag wrt altitude           |             | /GENF /  | 533)                | ACCEL<br>BL5<br>BL7<br>BL8<br>FH3<br>VT                                        | I<br>I                          | DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR<br>DRAGR           |
| DRAGV             |                | M P  | 'artial of drag ørt veloc(ty        |             | /GENF /0 | 532)                | ACCEL<br>8L5<br>8L7<br>8L8<br>FH3<br>VT                                        | I<br>I<br>I                     | DRAGY<br>DRAGY<br>DRAGY<br>DRAGY<br>DRAGY<br>DRAGY           |
| DREF              | $B_{ref}$      | I A  | erodynamic reference length         |             | /ARCDAT/ | 37)                 | VT                                                                             | 1                               | DREF                                                         |
| 1 ATM             |                | I A  | itwosphere option flag              |             | /ARCDAT/ | 7)                  | EQUAS<br>FXDAT<br>QUT<br>PDBC<br>VT                                            | 1<br>I<br>I                     | MTAI<br>MTAI<br>MTAI<br>MTAI<br>MTAI                         |
| JAER              |                | I A  | erodynamic model option flag        |             | /ARCDAT/ | 9)                  | BEROCO<br>EQUAS<br>GEINP<br>OUT<br>PROPB<br>PROPIN                             | 1<br>1<br>1<br>1                | JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER<br>JAER         |
| LIFT              | L              | О А  | erodynamic lift                     | (LB\$)      | /GENF /  | 496)                | ACCEL BL4 BL5 BL6 ENVPRM FH3 OUT PROPB PROPIN VI                               | I<br>I<br>I<br>I<br>I<br>0<br>0 | LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT<br>LIFT |

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| FORTRAN | MAIH<br>Symbol         | CODE | CODE DESCRIPTION                          |               | \$10R    |        | SUBROUTIN                                                      |                  |                                                              |
|---------|------------------------|------|-------------------------------------------|---------------|----------|--------|----------------------------------------------------------------|------------------|--------------------------------------------------------------|
| SYMBOL  |                        |      | DESCRIPTION                               |               | BIÜLK    | LOC    | SUBR                                                           | LUPE             | VAR                                                          |
| LIFTA   |                        | 0    | Partial of lift wrt angle-of attack       |               | /GENF /  | ( 531) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                        | I<br>I<br>I<br>I | LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA<br>LIFTA           |
| LIFTM   |                        | 0    | Partial of LIFT ørt mass                  |               | /GENF /  | ( 535) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                        | I<br>I<br>I<br>I | LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM<br>LIFTM           |
| LIFTR   |                        | 0    | Partial of lift wrt altitude              |               | /GENF /  | ( 530) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                        | I<br>I<br>I<br>I | LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR<br>LIFTR           |
| LIFTV   |                        |      | Partial of lift ort velocity              |               | /GENF /  | ( 529) | ACCEL<br>BL4<br>BL5<br>BL6<br>FH3<br>VT                        | I                | LIFTV<br>LIFTV<br>LIFTV<br>LIFTV<br>LIFTV<br>LIFTV           |
| MACHR   |                        | 1    | Partial of wach number wrt altitude       |               | /GENF /  | ( 524) | EQUA3<br>PROPB<br>PROPIA<br>VT                                 | 0<br>0<br>0<br>1 | MACHR<br>ZERO<br>ZERO<br>MACHR                               |
| MACHV   |                        | 1    | Partial of mach number mrt velocity       |               | /GENF /  | ( 525) | EBUA3<br>VV                                                    | 0<br>1           | MACHV<br>MACHV                                               |
| Q       |                        | 1    | Dynamic pressure                          | (PSF)         | /GENF /  | ( 303) | ENVPRO<br>EQUAS<br>OUT<br>POBC<br>VT                           |                  | 0<br>0<br>0<br>0                                             |
| QR      |                        | 1    | Partial of dynamic pressure wrt aitstude  |               | /GENF /  | ( 526) | EQUA3                                                          | M<br>I           | OR<br>OR                                                     |
| QS      |                        | I    | Product of dynamic pressure and aero. Ref | Area<br>(LBS) | /GENF /  | ( 304) | EQUA3                                                          | 0<br>1           | 0.5<br>0.5                                                   |
| ۵V      |                        | 1    | Partial of dynamic pressure wrt velocity  |               | /GENF /  | ( 527) | EQUAS<br>TEST<br>VT                                            | 14               | 6A<br>6A<br>6A                                               |
| SID     | sin(& <sub>E</sub> )   | m :  | See symbol                                |               | /GENF /  | ( 555) | EL2<br>DUT<br>VT                                               | 1                | SID<br>SID<br>SID                                            |
| SIDAE   | sin(α-ε <sub>E</sub> ) | 0 :  | See symbol.                               |               | /GENF /  | ( 557) | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>VT                 | I<br>I<br>I      | SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE<br>SIDAE  |
| SINA    | sìn∝                   | M :  | See symbol                                |               | /AECO3 / | ( 7)   | ACCEL<br>BL4<br>BL6<br>BL7<br>BL8<br>FH3<br>GUI3A<br>GUT<br>VT | I<br>I<br>M<br>I | SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA<br>SINA |

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| FORTRAN | HTAM                 | CODE | DESCRIPTION                                     | ESCRIPTION        |         | STORAGE    |      |                                                                                             | SUBROUTINE USAG                           |                                                                                       |  |
|---------|----------------------|------|-------------------------------------------------|-------------------|---------|------------|------|---------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------|--|
| SYMBOL  | SYMBOL               |      | DESCRIFTION                                     |                   | BLOCK   |            | LOC  | SUBA                                                                                        | CODE                                      | VAR                                                                                   |  |
| SREF    | S <sub>ref</sub>     | Ī    | Aerodynamic reference area (                    | FŢ <sup>2</sup> } | /ARCDAT | 77(        | 1)   | BNTG<br>EQUA3<br>FNTG<br>FXDAT<br>FXDAT<br>GEINP<br>SBINP<br>SBINP<br>SIZIN<br>THRUST<br>VT | 1<br>1<br>1<br>1<br>0<br>M<br>1<br>M<br>1 | ARCDA<br>SREF<br>ARCDA<br>ARCDA<br>I ARCDA<br>ARCDA<br>ARCDA<br>ARCDA<br>SREF<br>SREF |  |
| ULFT    | L                    | M    | Untrimmed mero.lift                             |                   | /GENF   | 70         | 540) | BL3<br>MODELA<br>VT                                                                         |                                           | ULFT<br>ULFT<br>ULFT                                                                  |  |
| ULFTA   |                      | M    | Partial of ULFT ørt angle of attack             |                   | /GENF   | 10         | 543) | BL3<br>VT                                                                                   | M                                         | ULFTA<br>ULFTA                                                                        |  |
| ULFTR   |                      | M    | Partial of ULFT wrt altitude                    |                   | /GENF   | /(         | 542) | BL3<br>VT                                                                                   | I<br>M                                    | ULFTR<br>ULFTR                                                                        |  |
| ULFTV   |                      | M    | Partial of ULFT ort velocity                    |                   | / GENF  | /(         | 541) | BL3<br>VT                                                                                   | I<br>M                                    | ULFTV<br>ULFTV                                                                        |  |
| XCG     | Х <sub>СБ</sub>      | I    | Center of gravity body x station                | (FT)              | /GENF   | /(         | 558) | EL2<br>EQUA3<br>VT                                                                          | I<br>I<br>I                               | XCG<br>XCG<br>XCG                                                                     |  |
| XCGM    | ∂X <sub>CG</sub> /∂m | 1    | See symbol                                      |                   | /AECO3  | <b>/</b> ( | 38)  | EL2<br>EQUA3<br>VT                                                                          | 1<br>0<br>1                               | XCGM<br>XCGM<br>XCGM                                                                  |  |
| XCGR    | X <sub>CGR</sub>     | 1    | Reference kcg location                          | (FT)              | /ARCDAT | 7(         | 32)  | VT                                                                                          | I                                         | XCGR                                                                                  |  |
| LX      | J                    | 1    | Control blend factor                            |                   | / GENF  | /(         | 560) | EL2<br>EQUA3<br>OUT<br>VT                                                                   | I<br>I<br>I                               | LX<br>CX<br>LX<br>LX                                                                  |  |
| XJR     |                      | 1    | Partial of blend factor wrt altitude            |                   | / GENF  | /(         | 562) | EL2<br>EQUA3<br>VT                                                                          | I<br>0<br>1                               | ALX<br>BLX<br>BLX                                                                     |  |
| X J V   |                      | I    | Partial of blend factor ort velocity            |                   | / SENF  | /(         | 561) | EL2<br>EQUA3<br>VT                                                                          | I<br>0<br>1                               | VLX<br>VLX<br>VLX                                                                     |  |
| XMCG    | $M_{CG}$             | M    | Aerodynamic moment about center of gravity (FT- | LBS)              | /GENF   | 7(         | 544) | EL2<br>OUT<br>VT                                                                            | i<br>1<br>M                               | XMCG<br>XMCG                                                                          |  |
| XMCGA   |                      | М    | Partial of XMCG wrt angle of attack             |                   | /GENF   | 10         | 547) | EL2<br>VT                                                                                   | I<br>m                                    | XMCGA<br>XMCGA                                                                        |  |
| XMCGM   |                      | M    | Partial of XMCG ort wass                        |                   | /GENF   | 11         | 548) | EL2<br>VT                                                                                   | I<br>M                                    | XMCGM<br>XMCGM                                                                        |  |
| XMCGR   |                      | M    | Partial of XMCG wrt altitude                    |                   | /GENF   | /(         | 546) | EL2                                                                                         | I<br>M                                    | XMCGR<br>XMCGR                                                                        |  |
| XWCGA   |                      | М    | Partial of XMCG ort velocity                    |                   | /GENF   | /(         | 545) | EL2<br>Vī                                                                                   | I                                         | XMCGV                                                                                 |  |
| XT      | X <sub>T</sub>       | I    | Aerodynamic trim surface body x station         |                   | /ARCDAT | r/C        | 36)  |                                                                                             | 1                                         | XT                                                                                    |  |
| ZCG     | Z <sub>CG</sub>      | I    | Center of gravity body z station                | (FT)              | /GENF   | /(         | 559) | EL2<br>EQUA3<br>VT                                                                          |                                           | ZCG<br>ZCG<br>ZCG                                                                     |  |
| ZCGM    | ∂Z <sub>CG</sub> /∂m | I    | See symbol                                      |                   | /AECO3  | /(         | 39)  | EL2<br>EDUA3<br>VT                                                                          | I<br>0<br>1                               | ZCGM<br>ZCGM<br>ZCGM                                                                  |  |
| ZCGR    | Z <sub>CGR</sub>     | I    | Reference zcg location                          | (FT)              | /ARCDAT | 7(         | 33)  | ٧T                                                                                          | I                                         | ZCGR                                                                                  |  |
| ZE      | ζE                   | 1    | Engine thrust centrold body z station           |                   | /ARCDAT | rzc        | 35)  | EL2<br>VT                                                                                   | I                                         | ZE<br>ZE                                                                              |  |
|         |                      |      |                                                 |                   |         |            |      |                                                                                             |                                           |                                                                                       |  |

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SUBROUTINE VT
REAL LCD, LSD, LCDA, LSDA
REAL LCD, LSD, LCDA, LSDA
*LSDR, LSDV, LSDVA, LSDVA, LSDRA, LSDVA, LSDRA, LSDVA,
*LSDR, LSDVV, LSDVA, LSDVA, LSDRA, LSDRA, LSDAA
COMMON/ARCDAT/
*SREF, LSDVV, LSDVA, LSDVA, LSDRA, LSDRA, LSDAA
COMMON/ARCDAT/
*SREF, LMDDE JAER JPRO QMAX GMAX
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, XMCGA
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   , XKG
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,XLAMP(9)
,ZCGM
,CMOM
   ,PDA
,SINPH1
,CDO
,CLGM
,FKM
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```
VT
VT
                          76
77
   ASSIGN 109 TO LABLE ASSIGN 1063 TO LABLE
   ASSIGN 109 TO LABLY
ASSIGN 1063 TO LABL5

100 SINA = SIN(ALPHA)
CDSA = COS(ALPHA)
SID = SIN(BELTAE)
COO = COS(OELTAE)
SIDAE = SINA+COD - COSA+SID
COOAE = COSA+COD + SINA*SID

104 IF(SREF LE C. -OR IATM EQ. 2) RETURN
CALL BEROCO
GO TO LABL3

1041 GWY = Q**MACHY
OMR = Q**MACHY
OMR = Q**MACHY
ULFTY = SREF*(QV*CL + QMV*CLM)
DRAGY = SREF*(QV*CL + QMV*CDN)
ULFTR = SREF*(QV*CL + QMV*CDN)
ULFTR = SREF*(QV*CL + QMV*CDN)
ULFTR = SREF*(QV*CL + QMV*CDN)
ULFTA = OS*CLA
ORAGA = OS*COA
ULFT = QS*CL
DRAG = QS*CD
IF(JAER .EO. 3) GO TO 107
GO TO LABL5

1061 CONTINUE
LIFTY = ULFTR
LIFTR = ULFTR
1063 LIFTA = ULFTA
LIFT = ULFT
RETURN

107 CALL MAMECO
   A TARANTARA TARA
7788123456789012345678901234
1001234
1001234
   107-
  - ULFTR

1053 LIFTA = ULFTA

LIFT = ULFT

RETURN

107 CALL MAMECO

SD = QS*PREF

LCD = ULFT*COSA + DRAG*SINA

LSD = ULFT*SINA - DRAG*COSA

LCDA = ULFT*SINA - DRAGA*COSA

LCDA = ULFT*SINA - DRAGA*COSA

LF = XCG - XCGR

ZF = ZCG - XCGR

ZF = ZCG - XCGR

VF = ZE - ZCB

WF = XT - XCG

FACTOR = XJ/WF

LCDAA = LCDA - LSD

LSDAA = LCDA + LCD

XMCGA = LCDA*XF + LSDAA*ZF + QSD*CMA

XMCGA = LCDA*XF + LSD*ZF + DB*YF + QSD*CM

GO TO LABL4

1071 SD = SREF*DREF

LCDV = COSA*ULFTV + SINA*DRAGV

LSDV = SINA*ULFTV - COSA*DRAGEV

LSDV = SINA*ULFTV - COSA*DRAGEV

LSDV = SINA*ULFTV - COSA*DRAGEN

XMCGQV = SD*(2V*CM + QNV*CM) + LCDV*XF + LSDV*ZF

XMCGG = LCD*XCGM + (LSD - DB)*ZCGM

ICGMWF = XCGN/WF

FACTV = XJV/WF

FACTV = XJV/WF

FACTV = XJV/WF

FACTV = XJV/WF

FACTV = FACTOR*XCGMWF

LIFTV = FACTOR*XCGMWF

LIFTV = FACTOR*XMCGV + FACTV*XMCG + ULFTV

LIFTM = FACTOR*XMCGM + FACTN*XMCG

RETURN

END
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# SUBRØUTINE YREF3

### Subroutine YREF 3

# Entry Points. YREF, PSD

### Purpose

Subroutine YREF3 (ENTRY YREF) refines cut-off time and state using third-order interpolation.

Entry PSD saves derivative at estimated cut-off point for use in entry YREF.

## Description

The equations and logic for the subroutine are described in Section 15.1 of Volume I. This routine is called for non-time arc cut-offs from FNTG.

| FORTBAN<br>SYMBOL | MATH<br>Symbol | CODI | DESCRIPTION                                                    | STORA<br>BIULK | JE<br>LOL | SUBROUTIN<br>SUBR COO                                                                                                                |                                                                                                     |
|-------------------|----------------|------|----------------------------------------------------------------|----------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| DT                |                | 0    | Integration interval (SEC)                                     | /GENF /(       | 300)      | BNTG M<br>FNTG M<br>REU3 I<br>RKTA3A I<br>RKTB3A I<br>STP3 I<br>YREF3 O                                                              | OT<br>OT<br>OT<br>P<br>P<br>OT                                                                      |
| DVAR              | ÿ              | I    | State vector derivatives in steepest descent module            | /STATE3/(      | 15)       | ADICBS M<br>ADICSA I<br>ADIDSA M<br>DERSA D<br>TENVPRM I<br>POBC I<br>PROPIN I<br>REUS I<br>RKTASA I<br>SDERS O<br>STPS I<br>YREFS I | DVAR<br>DVAR<br>OVAR<br>VT<br>VT<br>DVAR<br>VD<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>D |
| FP                |                | I    | Current value of cut-off function - non-linear only            | /GENF /(       | 521)      | OTF3 I<br>STP3 I<br>TOL3 I<br>YREF3 I                                                                                                | FP<br>FP<br>FP                                                                                      |
| FPD               |                | I    | Rate of change of non-linear cut-off function                  | /GENF /(       | 523)      | CON3 I<br>DTF3 I<br>STP3 I<br>YREF3 I                                                                                                | FPD<br>FPD<br>FPD                                                                                   |
| FPCLD             |                | I    | Value of non-linear cut-off function at prior compute interval | /GENF /(       | 522)      | OTF3 I<br>STP3 O<br>TOL3 O<br>YREF3 I                                                                                                | FPOLD<br>FPOLD<br>FPOLD<br>FPOLD                                                                    |
| NEQ               |                | 1    | Number of integrated states                                    | /XCODES/(      | 162)      | ADICB3 I ADIC3A I ADIC3A I ADIC3A I AGET3 I BGET3 I BST03 I BST03 I BST03 I BST03 I BST03 I SDINP M TOPM I TRANS I TRANS I TRAF3 I   | NEGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG                                                              |
| SVY               | y - 1          | I    | State and time array at previous compute interval              | /STATE3/C      | 236)      | DTF3 I<br>REU3 M<br>YREF3 I                                                                                                          | 2 4 A<br>2 A A<br>2 A A                                                                             |
| TIME              | t              | М    | Time (efapsed)                                                 | /GENF /(       | 493)      | CON3 I<br>DTF3 I<br>ENVPRM I<br>EQUA3 I                                                                                              |                                                                                                     |

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| FORTRAN<br>Symbol | MATH<br>Symbol | CODE            | DESCRIPTION                       |          | STORAG<br>HLUUK | Ε<br>100 | <u>5 04RD U</u><br>5 08R                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                          |
|-------------------|----------------|-----------------|-----------------------------------|----------|-----------------|----------|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| V                 | V              | M Relative weld | city (Fi                          | T/SEC)   | /STATE3/(       | 1)       | ACCEL ADICES ADJUST ASTS BLY BLS CONS DERS ENVPRM EDUAS MODELA MODELA MODELA MODELA TOPH PBC PCUSS RKTASA TOPM TYREFS   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | V 4 A R                                                                                  |
| VT                | ÿ              | I State vector  | derivatives in steepest descent x | eodu i e | /STATE3/{       | 15)      | ADICB3<br>ADIC3A<br>ADID3A<br>DER3A<br>DER3A<br>DENVPRM<br>POBC<br>PROPIN<br>REU3<br>RKTA3A<br>SDER3<br>SYREF3<br>YREF3 | I M 0 I I O I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I O I I I I O I I I I I I O I I I I I I I I I I I I I I I I I I I I | DVAR<br>DVAR<br>DVAR<br>VT<br>DVAR<br>VD<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR<br>DVAR |

YREF3

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SUBROUTINE YREF3(II,OM)
  0000
   REFINES CUT-OFF TIME AND STATE USING THIRD DRDER INTERPOLATION
   COMN
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STATE3D
STATE3D
  COMMON/STATE3/
  *VAR(14)

*XL(9,9)

*SINPSI

*SVBV

*UDV
  ,SVY(10)
,SAYBP(15)
,DCORD2
   STATE3D
STATE3D
STATE3D
STATE3D
  ODV
ODG
ODR
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GDO
  STATE THE PROPERTY OF THE STATE
   *UDR
*UDR
  HTOR
  TOL(9) , SVAR(10) , COTI(9,9) , DCGN(9) , DCGN
   , WDC( 20 )
DTP
, QS
, CS
, SUMSQ
, TR( 9 )
, W
, OMP
, TBU( 20 )
, MACHY
   SENF
   RENE
   GENF
GENF
   DRAGR
ISP
ULFTR
XMCGM
DELTAE
  DRAGA
ISPF
ULFTA
CODAE
,51D
  DBR
ULFT
XMCGR
CALPHA
XCG
  DHAGV
DB
,ULFTV
,XMCGA
,CDE
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, CT
, SIDAE
SENF ,
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*XMCG
*CULFT
*COD
COMMON /
*XJV
*FRATED
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, XK2V
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  , XK1
, XK1D
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XXCODDATA
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YREFF
YREFF
   C
C
3
   COMM
COMM
COMM
YREF3
  I IF STATE CUT OFF COMPUTE SPACING AND SET DERIVATIVES ELSE GO TO III IF(I.GT.7) GO TO 30
   30
```

20 OCT 72 G 01-46

```
H= V(I)- SVY(I+1)
HP= OM - SVY(I+1)
ZOM = SVDY(I)
ZON1 = VT (I)
  YREF3
YREF3
YREF3
YREF3
         76.
77.
78.
79.
  ZOM1 = V1 (1)

10 REZ=HP/H
RZ= REZ*REZ
B= RZ*(3.-2.*REZ)
AA=1.-B
C= REZ*(REZ-1.)**2
O= RZ *(REZ-1.)**2
O= RZ *(REZ-1.)**2
DT TIME = A**SYY(1) + B**TIME + H**(C/ZON + D/ZON1)
DT = TIME - SYY(1)
DD 20 IK= 1, NEQ
YDN= SVDY(IK)/ZDN
YON1= VT(IK)/ZDN1
Y(IK)=A**SYY(IK+1) + B**Y(IK) + H**(C**YON +D**YON1)
20 CONTINUE
RETURN
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81
  YREF3
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COMN
  III FUNCTION CUT-OFF COMPUTE SPACING AND DERIVATIVES
95. C

96.

97.

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103.

104. C

105. C

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1109.
  36 H= FP-FP0LD

HP=0M -FP0LD

ZON= FP0

MG=0

I=II+2

CALL PDBC (I,OVAR,SX,FPD,3,M0)

ZON1= FP0

GO TO 10
  YREF3
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   10-
  YREF3
COMM
COMM
COMM
YREF3
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  IV ENTRY USED TO STORE DERIVATIVE AT ESTIMATED CUT-OFF POINT FOR USE IN YREF ABOVE ENTRY PSD 00 40 K1=1, NEQ SVDY(K1)= VT(K1) IF(I1.LT.7) GO TO SO MO=0 I=I1+2 CALL PDBC (I,DVAR,SX,FPD,3,MO)
   50-
   112.
113.
114.
115.
116.
  5G CONTINUE
RETURN
END
  YREF3
YREF3
YREF3
```

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